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VOL. CXXXV.—No. 3503] LONDON: FRIDAY EVENING, FEBRUARY 16, 1923 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The High Commissioner for India is prepared to receive TENDERS for the SUPPLY of :—

BUFFERS AND BUFFER PLUNGERS.

Forms of Tender may be obtained from the Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, and Tenders are to be delivered at that office not later than Two o'clock p.m. on Friday, the 9th March, 1923.

T. RYAN,
Director-General.
1502

Engineer and Manager REQUIRED by the Government of Barbados for the Waterworks Department, for three years' service, with prospect of permanency.

Salary, £1000 a year. Selected candidate must himself bear the cost of his passage, &c., to the Colony. Candidates, preferably under 40 years of age and members of the Institution of Civil Engineers, who have specialised in Waterworks and have special knowledge of Searching for and Supplying Water, both by Gravitation and Pumping, and in the Construction and Maintenance of Works, must have had practical experience in the Distribution of Water in some city or populous district.—Apply at once by letter, giving age and brief details of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, S.W. 1, quoting M/10,260.
1557

Quantity Surveyor Required by the Government of the Tanganyika Territory for a tour of 20 to 30 months' service, with possible extension. Salary £450, rising to £500 a year by annual increments of £20, payable in the Territory in local currency, plus a temporary local allowance of 25 per cent. up to the 31st March, 1923, when the arrangement will be subject to review. Outfit allowance of £30 on first appointment. Free quarters and passages. Liberal leave in England on full salary. Candidates, aged about 25, preferably unmarried, should be fully qualified and experienced Quantity Surveyors and should be Fellows of the Surveyors' Institution.—Apply at once by letter, stating age, whether married or single, and giving a brief account of experience and qualifications, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/11,776.
1501

INDIAN SERVICE OF ENGINEERS.

The Secretary of State for India in Council will, in 1923, APPOINT 11 ASSISTANT EXECUTIVE ENGINEERS for this Service if so many suitable candidates present themselves.

Every candidate must be a British subject or a ruler or subject of any State in India in respect of whom the Governor-General of India in Council has made a declaration that he is to be considered eligible.

European candidates who were of military age prior to November, 1918, must have served in His Majesty's Forces during the war, or have been prevented on adequate grounds from so serving. European candidates must have been born on or after 2nd August, 1896, and on or before 1st August, 1901.

Indian candidates must have attained the age of 21 and not attained the age of 24 years on 1st July, 1923, except that in the case of an Indian who has rendered service of the nature defined in the preceding paragraph, the same maximum age limit as for Europeans will apply.

Every candidate must either (1) have obtained one of certain recognised university degrees or other distinctions in engineering, or (2) have passed Sections A and B of the Associate Membership Examination of the Institution of Civil Engineers, or been exempted by the Institution from such examination, or (3) produce the required evidence that he is otherwise eligible under the regulations.

Applications from candidates must reach the India Office not later than 1st April. Printed forms, together with information regarding the conditions of appointment, may now be obtained from the SECRETARY, Public Works Department, India Office, Whitehall, London, S.W. 1.

India Office, London,
11th December, 1922.
1100

In the High Court of Justice, No. 00618 of 1922.
Chancery Division.
Mr. Justice P. O. Lawrence.

In the Matter of The LUNE VALLEY ENGINEERING COMPANY Limited and Reduced;
and
In the Matter of The COMPANIES (CONSOLIDATION) ACT, 1908.

Notice is Hereby Given that a PETITION was on the 8th day of December 1922 presented to His Majesty's High Court of Justice for the CONFIRMATION of the REDUCTION of the CAPITAL of the above named Company from £20,000 to £7304 4s. And NOTICE IS HEREBY FURTHER GIVEN that the said PETITION is directed to be HEARD before His Lordship Mr. Justice Astbury on TUESDAY, the 27th DAY of FEBRUARY, 1923. Any Creditor or Shareholder of the said Company desiring to oppose the making of an Order for the confirmation of the said reduction of capital should appear at the time of hearing in person or by counsel for that purpose.

A copy of the said Petition will be furnished to any such person requiring the same by the undersigned on payment of the regulated charge for the same.

Dated 13th day of February 1923.

BELL, BRODRICK and GRAY,
of 62, Queen Victoria street, E.C. 4,
Agents for HALL MARSHALL and SEWART,
of Leicester,
Solicitors for the Company.
1529

METAL WORKERS.

THE WORSHIPFUL COMPANY OF ARMOURERS AND BRASIERS in conjunction with THE WORSHIPFUL COMPANY OF CARPENTERS.

TRADES TRAINING SCHOOL.

153, Great Titchfield-street, W. 1, near Great Portland-street Station, Metropolitan Railway.

PRACTICAL CLASSES FOR BRAZIERS AND SMITHS.

Open to those engaged in the trade.

BRASS AND COPPER WORK—Instructor: Mr. E. N. COLDWELL.
IRONWORK—Instructor: Mr. H. COLLINS.

CLASS NIGHTS—Ironwork: Tuesdays and Thursdays, 7 to 9.30.
Brass and Copper Work: Wednesdays and Fridays, 7 to 9.30 p.m.
FEES—Adults, 5s. per term; apprentices and improvers, 2s. per term.

Students can join the classes at any time.
2nd Term: February 19th, 1923, to May 4th, 1923.
SYDNEY PITT,
Clerk.
Armourers' Hall,
81 Coleman-street, E.C. 2.
1504

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

The Air Conference—No. II.

A Discussion on Engine Indicators.

Vane Wheel Propulsion.

A Brown Coal Power Project.

A London White-Metal Foundry.

New Landing Stage and Wharf at Gosport.

The Use of Models in Engineering.

Tensile Tests of Materials at High Temperatures.

PUBLIC NOTICES

University of London.

A COURSE of FOUR LECTURES on "THE CONTROL OF THE SPEED AND POWER FACTOR OF INDUCTION MOTORS" will be given by PROFESSOR MILES WALKER, M.A., D.Sc. (Professor of Electrical Engineering in the University of Manchester), at the INSTITUTION OF ELECTRICAL ENGINEERS, Savoy-place, Victoria Embankment, W.C. 2, on WEDNESDAY, FEBRUARY 21st; MONDAY, FEBRUARY 26th; WEDNESDAY, MARCH 14th; and WEDNESDAY, MARCH 21st, 1923, at 5.15 p.m. At the first Lecture the chair will be taken by the President of the Institution of Electrical Engineers (Frank Gill, Esq.). Syllabus of the Lectures obtainable on application to the undersigned. ADMISSION FREE, WITHOUT TICKET.

EDWIN DELLER,
Academic Registrar.
1383

Administrative County of LONDON.
SCAVENGING, &c. THAMES EMBANKMENTS AND BRIDGES.

The London County Council invites TENDERS for the SCAVENGING, &c., of the THAMES EMBANKMENTS and BRIDGES for a contract for twelve months, commencing 1st April, 1923.

Persons desiring to Tender may obtain the form of Tender, &c., on application to the Chief Engineer at the Old County Hall, Spring Gardens, S.W. 1, upon payment of the sum of £2. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before the payment of the fee.

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 26th February, 1923, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
Clerk of the London County Council.
1520

City of Nottingham.

The Tramways Committee are prepared to receive TENDERS for the SUPPLY and DELIVERY of 300 TONS of STEEL TRAMWAY RAILS.

Copies of the specification and form of Tender may be obtained on applying to Mr. T. Wallis Gordon, City Engineer and Surveyor, Guildhall, Nottingham, on payment of a deposit of One Pound, which will be returned on receipt of a bona fide Tender and the copy of the specification.

Sealed Tenders, in the official envelope provided, are to be delivered to the undersigned not later than 9 a.m. on Thursday, 1st March, 1923.

The lowest or any Tender will not necessarily be accepted, and the Committee reserve to themselves the right to divide the work.

Tenders will only be accepted from firms who conform to the conditions of the contract as regard paying the local standard rate of wages, &c.

W. J. BOARD,
Town Clerk.
Guildhall, Nottingham,
13th February, 1923.
1538

East Indian Railway.

The Directors are prepared to receive up to Eleven o'clock a.m., TENDERS for the SUPPLY of—
(1) WHEELS and AXLES for CARRIAGES and WAGONS.
(2) BOGIE CARRIAGES.
(3) LOCOMOTIVES ENGINES (2-6-2 Shunting Tank Type),
for No. 1 on Wednesday, the 28th February instant, and for Nos. 2 and 3 on Wednesday, the 7th March proximo.

Copies of the specifications can be obtained at the Company's Offices on payment of £1 1s. each. This fee will not be returned.

G. E. LILLIE,
Secretary.
78-76, King William-street, London, E.C. 4.
15th February, 1923.
1571

PUBLIC NOTICES

Borough of Portsmouth.

The Portsmouth Town Council invite TENDERS for the STRENGTHENING of the FACING PILES to the LANDING STAGE of the SOUTH PARADE PIER, SOUTHSEA, by the addition of greenheart piles, &c., and for the MAINTENANCE of the same in thorough repair for six calendar months from the completion thereof.

Copies of the drawings and specification can be obtained on application (accompanied by the sum of £2 2s., which will be refunded on the return of the documents within three days or on the receipt of a bona fide Tender accompanied by the drawings and specification) to Mr. Arthur W. Ward, Borough Engineer, Town Hall, Portsmouth, from whom any further particulars can be obtained.

The work will have to be carried out under the trade union rules in force in the borough.

Tenders, marked "Tender for Work to Landing Stage, South Parade Pier," are to be sent in on the form supplied, accompanied by the drawings and specification issued by the Corporation, and must reach the undersigned not later than 10 a.m. on Monday, the 19th February, 1923.

The Council do not bind themselves to accept the lowest or any Tender.

F. J. SPARKS,
Town Clerk.
The Town Hall, Portsmouth,
6th February, 1923.
1511

Borough of Richmond (Surrey).

SALE OF STEAM PLANT.

The Council offer FOR SALE by TENDER TWO COMPOUND CONDENSING BEAM ENGINES; H.P. cylinders, 18½in. diameter, 37in. stroke; L.P. cylinder, 30in. diameter, 54in. stroke; revs., 34 per minute; fly-wheels, 16ft. in diameter; steam pressure, 80 lb. per square inch.

The plant will be sold as it stands.

It is anticipated that the first set will be available for removal by May and the second set by August, 1923.

Full particulars and forms of Tender can be obtained from Mr. H. Will. Apted, Assoc. M. Inst. C.E., Water Engineer, Waterworks, Richmond, Surrey.

Tenders must be addressed to the undersigned, endorsed "Tenders for Beam Engines," so as to be received by him not later than March 6th, 1923.

The Council do not undertake to accept the highest or any Tender.

HENRY SAGAR,
Town Clerk.
Town Hall,
Richmond (Surrey),
February, 1923.
1519

Romford Rural District Council.

RIVERSIDE SEWERAGE—RAINHAM SECTION.

The above Council are prepared to receive TENDERS for the CONSTRUCTION of about 600 YARDS of 24in., 727 YARDS of 21in., and 725 YARDS of 18in. diameter PIPE SEWER, including TIDAL CREEK and RAILWAY CROSSINGS, MANHOLES, FLUSHING TANK, and other incidental WORKS in the Parishes of Rainham and Hornchurch, Essex.

Drawings, specification and quantities can be inspected at the office of Mr. W. J. Grant, Surveyor to the Council, 14a, South-street, Romford; also at the office of Mr. William Fairley, Consulting Engineer, Parliament Mansions, Victoria-street, Westminster, S.W. 1.

A copy of the bill of quantities and form of Tender can be obtained on deposit of a crossed cheque for £3 3s., made payable to the Council, which deposit will be returned on receipt of a bona fide Tender.

Sealed Tenders must be delivered to the undersigned on or before Monday, March 12th, 1923.

The Council do not bind themselves to accept the lowest or any Tender.

T. W. A. GREENHALGH,
Clerk to the Council.
16a, South-street, Romford,
14th February, 1923.
1540

PUBLIC NOTICES

Tilbury Urban District Council.

UNEMPLOYMENT RELIEF WORKS NO. 5.
ELECTRICAL VEHICLES FOR COLLECTION OF REFUSE, AND PLANT FOR CHARGING SAME.

The above Council invite TENDERS for the SUPPLY of :—

A.—ONE 60 K.W. Steam-driven Continuous-current Compound Wound GENERATING SET, including BATTERY CHARGING PANELS for 2 Battery Charging Vehicle Circuits complete.

B.—TWO (gross carrying capacity about 3½ tons) ELECTRIC VEHICLE CHASSIS fitted with Hand-operated End Tipping Bodies for Refuse Collection.

Forms of Tender can be obtained from Mr. S. A. Hill-Willis, Engineer to the Council.

Tenders, endorsed "Unemployment Relief Works No. 5," must be sent to the undersigned not later than Twelve Noon, Saturday, 24th inst.

The lowest or any Tender will not necessarily be accepted.

By Order,
A. W. BUCKNER,
Clerk of the Council.
Council Offices, Tilbury,
13th February, 1923.
1521

The Great Indian Peninsula RAILWAY COMPANY.

The Directors are prepared to receive TENDERS for the SUPPLY of the following STORES, namely :—

No.		Fee for Specification.
1.	STEEL WORK FOR BRIDGES	£1
2.	BIB COCKS, &c.	5s.
3.	LAMPS AND FITTINGS	7s. 6d.
4.	RAILWAY TICKETS	10s.
5.	SIEVES, &c.	2s. 6d.
6.	FENCING WIRE STRAND	7s. 6d.
7.	TWINES, &c.	2s. 6d.
8.	WOOD HANDLES	2s. 6d.
9.	BELLOWS	5s.
10.	INDIA-RUBBER HOSE PIPES, SHEETS, &c.	7s. 6d.
11.	CAST IRON SLUICE VALVES, &c.	2s. 6d.
12.	LEATHER BELTING, &c.	7s. 6d.
13.	LAMINATED SPRINGS	10s.
14.	LAMP GLASSES, &c.	2s. 6d.
15.	PLATE GLASS	5s.
16.	WICKS	2s. 6d.

Specifications and forms of Tender may be obtained at this office on payment of the fee for the specification, which payment will not be returned.

The fee should accompany any application by post. Cheques and postal orders should be crossed and made payable to the Great Indian Peninsula Railway Company.

Tenders must be delivered in separate envelopes, sealed and addressed to the undersigned, marked "Tender for Steel Work for Bridges," or as the case may be, not later than Eleven o'clock a.m. on Tuesday the 27th February, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

R. H. WALPOLE,
Secretary.
Company's Offices,
48, Cophall-avenue, E.C. 2,
London, 14th February, 1923.
1545

Municipality of George Town, PENANG, STRAITS SETTLEMENTS.
JUNIOR ASSISTANT ENGINEER.

The Municipal Commissioners of George Town, Penang REQUIRE an ASSISTANT to the MUNICIPAL ENGINEER, age 22 to 26, preferably unmarried, on a three years' agreement, with possible extension. Applicants must have had a good technical education and a regular training as pupil and assistant with a Borough or County Engineer or a Civil Engineer in private practice, with experience in Municipal and General Engineering Work, including Roads, Buildings, Bridges, Sewerage and Conservancy Details, and the control of workmen. It is desirable that candidates should have passed the examination of the Institution of Civil Engineers or the testamur examination of the Institution of Municipal and County Engineers.

Salary 5400 dollars for the first year, rising by biennial increments of 600 dollars a year to a maximum of 9000 dollars per annum, paid monthly in dollars, the currency of the Colony, the value of the dollar being 2s. 4d. sterling. The pay of the appointment at this rate for the first year would be £630. An allowance of 1320 dollars per annum for the maintenance of a motor car will be granted. Free passage will be provided, with half-pay during the voyage out. The selected candidate must pass an approved medical examination.

Applications, stating whether married or single, age, birthplace, and giving details of education, training, and experience generally, with particular reference to the items mentioned above, and copies (only) of testimonials, to be lodged with Messrs. C. C. LINDSAY and PEIRCE, MM. Inst. C.E., 150, Hope-street, Glasgow, Agents for the Commissioners (who will give further particulars if requested), not later than Tuesday, 20th February, 1923.
1483

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PUBLIC NOTICES

The Madras and Southern MAHRATTA RAILWAY COMPANY, LTD.

The Directors are prepared to receive TENDERS for :
(i.) SKEW GIRDER BRIDGES (3 Pony Truss Spans, 83ft. and 97ft. 6in. clear through spans. Approximate weight with Bolts and Washers, 245 tons).
(ii.) 388,000 DOG SPIKES for (B.S.) 60 lb. F.F. Rails ;
(iii.) 12 TONS DRY RED LEAD ;
3 TONS DRY WHITE LEAD ;
54 TONS MOIST WHITE LEAD ;
in accordance with the specifications which may be seen at the offices of the Company. The charge for each of the specifications is One Guinea, which will not be returned.

Tenders must be sent in, addressed to the SECRETARY, not later than 2 p.m. on Tuesday, 27th February, 1923, and marked "Tender for Girder Bridges," or as the case may be.

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices :
25, Buckingham Palace-road,
Westminster, S.W. 1,
13th Februarry, 1923. 1542

SITUATIONS OPEN

WANTED, ASSISTANT to SALES MANAGER of Motor Cycle Works ; experience of Export Sales essential, knowledge of deferred payments and languages an advantage.—Address, giving fullest details of experience, age, whether married, and salary required (useless to apply unless experienced). 1553, The Engineer Office. 1553 A

WANTED, in the Editorial Office of an Important weekly trade journal, a YOUNG MAN possessing recognised Engineering or Metallurgical Qualifications, who Writes English Easily and Correctly. Some experience of newspaper work and a knowledge of French or German desirable. Permanency.—Write, giving full particulars, to "AGRO," c.o. J. W. Vickers and Co., Ltd., 5, Nicholas-lane, E.C. 4. 1559 A

A LARGE MANUFACTURING FIRM in the North Midlands, sending to all parts of the world, invite APPLICATIONS from thoroughly capable men for the POSITION of HEAD of their TRANSPORT DEPARTMENT.

The Department takes charge of all inwards and outwards traffic by rail, road and sea, besides the movement of all materials and articles inside the works and the maintenance of locos., wagons and lorries.

Only candidates who have had actual experience in general railway working, rates, consigning, routeing, and control of works rolling stock need apply. Engineering training preferred, but experience in shipping, freights and marine insurance also an advantage.

Address, 1555, The Engineer Office. 1555 A

ENGINEER WANTED, with £500 to £750 Capital, to Take Over Management of Small Works opening in Birmingham to produce patented and other domestic articles with growing sale. Debentures given. Salary £275 to £325.—Address, 1543, The Engineer Office. 1543 A

ESTABLISHED CONSTRUCTIONAL ENGINEERING FIRM (employing 30-40 hands), with specialities, REQUIRE thoroughly practical WORKS MANAGER to increase output. Energetic worker, able to invest £1000-£2000, with seat on board and reasonable salary. Give particulars of experience and age in strict confidence.—Address, 1552, The Engineer Office. 1552 A

HEATING.—Well-established London FIRM REQUIRE SERVICES of thoroughly competent and energetic MANAGER ; must be capable of drawing out the most modern schemes of Heating, Domestic Supply, Drying and Ventilating. Applicants must be able to control staff of men and carry out contracts to a conclusion. Only experienced man need apply. Lucrative position is offered.—Address, P6852, The Engineer Office. P6852 A

LARGE FIRM of Electrical Manufacturers REQUIRE CHIEF ENGINEER for Switchgear Department. Must be thoroughly conversant with all Types of Switchgear, particularly A.C. and D.C. Starters and Control Gear.—Address, stating age, full particulars of qualifications and salary required. P6912, The Engineer Office. P6912 A

STRUCTURAL STEELWORK.—REQUIRED IMMEDIATELY, ONE SENIOR and ONE JUNIOR DRAUGHTSMAN, accustomed to DESIGN and Abstracting Quantities, Steel-framed Buildings, Workshops, &c. Only structural men need apply.—Address, P6949, The Engineer Office. P6949 A

TEST ROOM.—ASSISTANT MANAGER REQUIRED for Test Room of Large Electrical Manufacturing Company. Must be fully acquainted with the Testing, Inspecting and Adjusting of Large D.C. and A.C. Motors and Generators, also Turbo-generators of larger sizes. Only people with over six years' experience in test room considered.—Address, giving full particulars of past services, education, and salary expected, 1534, The Engineer Office. 1534 A

THE MOTHERWELL IRON and STEEL CO., Ltd., REQUIRE a capable GENERAL MANAGER for their Steel Works, with experience of Buying Materials and Selling Finished Steel Products and knowledge of Finance and Organisation. State age, experience, and salary desired.—Address applications, which will be treated in strict confidence, to Mr. W. M. MARSHALL, 3, Merry-street, Motherwell. 1537 A

WATERWORKS ENGINEER'S ASSISTANT REQUIRED temporarily. Public waterworks experience essential ; good Surveyor and Leveller.—Address, stating salary required, qualifications, and age, 1523, The Engineer Office. 1523 A

YOUNG MAN WANTED in Sales Department for Compressed Air Plant and Sandries. State age, experience, and salary required.—Address, 1539, The Engineer Office. 1539 A

WANTED, Temporarily, MECHANICAL DRAUGHTSMAN, experienced in Waterworks Ironwork and Bridge Design. Give full particulars of experience, age, and salary required.—Address, 1522, The Engineer Office. 1522 A

WANTED IMMEDIATELY, TWO Young Journeymen DRAUGHTSMEN, with sound mechanical training. A little knowledge of building and steel work construction an advantage.—Address, giving age, experience, and wages required, 1512, The Engineer Office. 1512 A

DRAUGHTSMAN, Experienced in Lay-out of Rolling Mills and Miscellaneous Plant. Must be quick and reliable. State salary required. Good prospects. —Address, 1490, The Engineer Office. 1490 A

DRAUGHTSMAN REQUIRED by a Firm of Manufacturing Engineers. Must be thoroughly experienced in the Design of High-speed Air Compressors of all types, and Winding Engines, steam and electrically driven.—Address, stating age, full particulars regarding experience, and salary required, 1394, The Engineer Office. 1394 A

DRAUGHTSMAN REQUIRED for Works in Midlands ; used to Gasholders and Gasworks Plants. State age, salary, and full particulars of experience.—Address, 1531, The Engineer Office. 1531 A

DRAUGHTSMAN REQUIRED. Must be Accustomed to the Design and Lay-out of Modern Woodworking Machinery. Particulars of experience and wages expected.—Address, 1510, The Engineer Office. 1510 A

DRAUGHTSMAN WANTED, Used to Designing Ventilating, Dust Removal, and Plenum Plants. —Write, stating age, experience, and salary required, to Box 127, c/o Mather and Crowther, Ltd., 10, New Bridge-street, E.C. 4. 1527 A

SITUATIONS OPEN (continued)

DRAUGHTSMEN.—TWO Experienced MARINE AUXILIARY PUMP DRAUGHTSMEN WANTED AT ONCE in the East Midlands. State age, experience, and salary required.—Address, 1516, The Engineer Office. 1516 A

ENGINEER'S DRAUGHTSMAN REQUIRED, Used to Involute and Bevel Gearing ; London district. State reference, salary, and age.—Address, 1514, The Engineer Office. 1514 A

EXPERIENCED HEAD DRAUGHTSMAN, to be over about six others ; knowledge of Drying Machinery, Steam Engines and Millwrighting would be useful. Advertisers are well-known East Lancashire engineering firm. Give full particulars of experience, age, salary, &c.—Address, 1549, The Engineer Office. 1549 A

JUNIOR DRAUGHTSMAN, to Assist in Design of Tools, Jigs, and Special Machinery in Liverpool. State experience and wage required.—Address, P6938, The Engineer Office. P6938 A

LEADING DRAUGHTSMAN REQUIRED for London office, with good all-round experience in Designing all kinds of Cranes and Lifting Apparatus. Must be quick and accurate.—Apply by letter, giving full particulars of education, training, experience, and salary required, Box 7542, c/o Brown's, 29, Tothill-street, S.W. 1. 1509 A

REQUIRED, LADY TRACER ; must be Quick and accurate.—Write, giving details of experience, age, and salary required, to FULLER'S UNITED ELECTRIC WORKS, Chadwell Heath, Essex. P6911 A

WANTED AT ONCE, ASSISTANT FOREMAN for Railway Wood Wagon Building and Sawmill in an old-established works in the Midlands. State age, experience, and salary required ; permanency for suitable man.—Address, 1505, The Engineer Office. 1505 A

WANTED, CHIEF FOREMAN for Modern Constructional Engineering Works, including Smiths' Shop, Hydraulic Presses, Fitting Shop, with knowledge of Costs and Labour-saving Methods. Excellent opportunity.—Address, P6901, The Engineer Office. P6901 A

FOREMAN for GUN-METAL FOUNDRY ; Young, energetic, capable of making high-class Hydraulic Castings and experienced with Moulding Machinery and up-to-date methods.—Address, 1453, The Engineer Office. 1453 A

MESSRS. RANSOMES and RAPIER, Ltd., REQUIRE the SERVICES of an ASSISTANT FOREMAN in their Foundry Dept.—Applications, stating age, previous experience, and salary required, to be addressed to WATERSIDE WORKS, Ipswich. 1517 A

STAFF FOREMAN REQUIRED for Carriage and Wagon Steel Frame Department. Must be first-class man. State age, experience, and salary required. Apply in confidence to Works Manager, CRAVENS RAILWAY CARRIAGE and WAGON CO., Ltd., Darnall, Sheffield. 1515 A

TOOLMAKERS WANTED as Section Charge Men in the manufacturing departments of large factory near Glasgow. Please give particulars of technical and practical training, age, &c.—Address, "TOOLS," Wm. Porteous and Co., Advertising Agents, Glasgow. 1446 A

ESTIMATOR REQUIRED, Accustomed to Tendering for Electric Motors, Generators, &c. Applicants state age, education, experience, and salary required.—Address, 1481, The Engineer Office. 1481 A

SITUATIONS WANTED

WANTED, POSITION of ENGINEERING SHOP MANAGER ; good organiser, with good testimonials, having held similar position with prominent engineering firms.—Address, P6824, The Engineer Office. P6824 B

A LONDON B.Sc. (Engineering), Aged 21, DESIRES POST as Assistant in Civil or Mechanical Engineer's Office ; experience, not salary, chief consideration.—A. L. B., 21, Chardmore-road, N. 16. P6906 B

A POST REQUIRED by Educated Gentleman in any capacity ; 32, married, good references, methodical, reliable, honest ; as Office Manager, Assistant Manager or Engineer, &c. ; good correspondent, fair French, trained engineer, university and works. Held positions as Assistant Engineer ; war service. Genuine inquiries invited, when full particulars sent.
Address, P6917, The Engineer Office. P6917 B

ADVERTISER, a Public School Man, 24, 2 Years university, 5 years' apprenticeship, fully qualified mechanical engineer, A.M.I.M.E., REQUIRES permanent APPOINTMENT at home or abroad. Previous posts include assistant works manager, works manager ; has experience in Near East ; speaks French, Arabic.—Address, P6836, The Engineer Office. P6836 B

ADVERTISER (39), Public School Man, Holding responsible position on engineering staff of large manufacturing concern, DESIRES CHANGE ; permanent engagement only considered.—Address, P6914, The Engineer Office. P6914 B

AS GEN. MAN., WORKS MAN., OR REPRESENTATIVE.—MECH. ENGINEER (44), A.M.I. Mech. E., WANTS responsible POSITION ; wide experience works management, construction and maintenance plants and ropeways ; good organiser, with energy and initiative ; speciality, costs, bonus and stores systems ; first-class testimonials.—Address, P6910, The Engineer Office. P6910 B

ASSISTANT ENGINEER (23) DESIRES SIT. ; 3 yrs. shops, 4 yrs. D.O., designing, estimating, general office routine, testing and supervising construction of marine, steam and hydraulic work, valves, &c.—Address, P6900, The Engineer Office. P6900 B

BUYER.—The MANAGER of a Large Engineering Works Purchasing Dept., who has an exceptionally wide knowledge of the markets of the country, DESIRES to NEGOTIATE NEW APPOINTMENT.—Write, Z. M., 613, c/o Deacon's, Leadenhall-street, E.C. 1489 B

CENTRIFUGAL PUMPING PLANT.—ENGLISHMAN (42), A.M.I. Mech. E., with wide experience of design, building and cost of this class of work, as well as sound general knowledge, WANTS BERTH. Excellent references ; moderate salary.—Address, P6931, The Engineer Office. P6931 B

CIVIL ENGINEER (26), ex-Officer, B.A., B.A.I. (Dublin), WANTS EXPERIENCE, preferably in reinforced concrete construction or hydraulic engineering ; small salary.—Address, P6929, The Engineer Office. P6929 B

CONSTRUCTIONAL ENGINEER (31), A.C.G.I., experience mass concrete foundations, chimneys, flues, erection of steel buildings, plant, machinery, boilers, furnaces, surveying, levelling, control of men, DISENGAGED any time ; home or abroad if necessary.—Address, P6925, The Engineer Office. P6925 B

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SITUATIONS WANTED (continued)

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ENGINEER, A.M.I.M.E., A.M.I.E. (India), at present holding important appointment in India, with 20 years' mechanical and electrical engineering experience in England and India, REQUIRES ACTIVE PARTNERSHIP with firm of mechanical, electrical, or motor engineers engaged in the manufacture of accessories, &c. Can invest about £2000. Manchester or London district preferred.—Address, P6937, The Engineer Office. P6937 B

ENGINEER, B.Sc. (Lond.), Assoc. M. Inst. C.E., formerly on staff of leading railway, now with constructional firm, DESIRES CHANGE with good prospects. Experienced all classes structural work, buildings, roofs, bridges, &c. ; 15 year shops, drawing-office, outside experience ; used control staff, entire responsibility. Royal Engineer officer during war.—Address, P6855, The Engineer Office. P6855 B

ENGINEER, 20 Years' Training and Experience, OXY-acetylene and electric welding expert, IS OPEN to ACCEPT POSITION as Works Manager or other responsible post, home or abroad.—Address, P6939, The Engineer Office. P6939 B

ENGINEER (22), Well up in Mechanics and Modern shop practice, WISHES to FILL JUNIOR EXECUTIVE POSITION ; good references.—NEAL, Engineers, Kettering. P6904 B

ENGINEER (34), with Long Experience in Several branches of mechanical engineering, shops, D.O. and managerial depts., specially conversant with rotary newspaper magazine and other printing presses, good electrical exp., excellent testimonials, last position supervising engineer to group of five factories (large and medium sized), DESIRES APPOINTMENT. —Address, P6837, The Engineer Office. P6837 B

ENGINEER, Mechanical and Electrical, DESIRES POST, Works Engineer. Sound shop and D.O. experience, gas, chemical, steam, &c., works maintenance and erection. At liberty near future.—Address, P6859, The Engineer Office. P6859 B

ENGINEER REQUIRES Permanent, Progressive APPOINTMENT ; public school man, 3 years University, 5 years apprenticeship, 12 years' practical, technical and commercial experience in mechanical, constructional and public works at home and abroad ; previous engagements include clerk of works, chief draughtsman, chief engineer, London office manager.—F., 2, Summerlands-crescent, Acton, W. 3. P6907 B

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INVENTOR SEEKS POSITION as DESIGNER with motor, motor cycle, aircraft, tool or machine manufacturers. Invent or design anything mechanical. Moderate remuneration.—Address, P6940, The Engineer Office. P6940 B

OFFICE MANAGER, 42 Years of Age, DESIRES CHANGE ; thoroughly experienced in office routine, estimating, cost accountancy, buying, correspondence, statistics, and the application of modern methods to the best advantage ; first-class organising ability, possessing tact and initiative.—Address, P6934, The Engineer Office. P6934 B

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SKILLED ENGINEER SEEKS SITUATION ; thoroughly experienced in marine installation ; 11 years' experience.—Address, P6860, The Engineer Office. P6860 B

TO FIRMS REQUIRING REPRESENTATIVE or WISHING to EXTEND PRESENT BUSINESS in INDIA and FAR EAST.—ENGINEER (32), accustomed responsibility and hard work, returning from India April, 1923, DESIRES NEGOTIATE ENGAGEMENT as Branch Manager or Assistant ; 18 years' experience manufacturing, maintenance, purchasing, sales, all classes engineering machinery and appliances, well educated, good address, capable taking charge sales or manufacturing side, well up shipping accounts, correspondence, publicity, highest references ; willing to travel.—Address, P6747, The Engineer Office. P6747 B

WORKS MANAGER (Aged 42) DESIRES Responsible POSITION with a firm of Steel Constructional Engineers. Would invest up to £1000. Sound works, D.O., and commercial experience ; highest references.—Address, P6946, The Engineer Office. P6946 B

WORKS MANAGER, Excellent Long Service record with general engineers and ironfounders, SEEKS SIMILAR POSITION ; well-educated man, with sound works and D.O. experience, good organiser, successful control of labour ; moderate salary.—Address, P6884, The Engineer Office. P6884 B

CHIEF DRAUGHTSMAN (Machine Tools), 25 Years experience, REQUIRES similar POSITION or Manager ; good organiser, successful control of labour. —Address, P6812, The Engineer Office. P6812 B

DRAUGHTSMAN (Age 31) DESIRES SITUATION ; exp., 7½ yrs. works and D.O., with large rly. wks., 2½ yrs. hand cranes and mechanical structure design, 5½ yrs. motor and aircraft mach. and gen. mech. designs.—Address, P6891, The Engineer Office. P6891 B

DRAUGHTSMAN (MECHANICAL) (28), REQUIRES SIT. in London ; 9 years' experience, chem. wks. plant, mining, mech., and general.—Address, P6915, The Engineer Office. P6915 B

ENGINEERING DRAUGHTSMAN (24) REQUIRES JOB ; 18 years' shops and D.O. experience on mechanical filtration, refrigeration, contractors and general machinery.—Address, P6944, The Engineer Office. P6944 B

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SITUATIONS WANTED (continued)

MECHANICAL DRAUGHTSMAN (27) SEEKS POST with General Engineering Firm, London district ; disabled ex-Service man. Interview solicited.—Address, P6935, The Engineer Office. P6935 B

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For continuation of Small Advertisements see page 3.

The Morwell Brown Coal and Electrical Scheme, Victoria, Australia.

THE Victorian Government has long desired to centralise the generation of energy at a given point and to distribute it electrically over the whole State. In 1908 Mr. Charles H. Merz prepared a report for the Victorian Government dealing with the question of power supply for Victoria, and in 1912 he prepared a further report for the Government. In the latter report the establishing of a steam-operated power-house at Morwell, in Gippsland, approximately 80 miles from Melbourne, was recommended. Nothing further was done until 1917, when the presidential address of Mr. H. R. Harper—who at that time was the city electrical engineer for Melbourne—to the Victorian Institute of Engineers, drew attention to the fact that the existing power-houses around Melbourne would not be able to meet the demand that was in sight, and recommended that the policy of development, as laid down by Mr. Merz, should be followed. This statement was brought under the notice of the Government, which appointed a committee to advise whether, in the event of the State undertaking the generation and distribution of electrical energy in bulk, such a proposition would be economically sound.

The report of this committee, after pointing out the necessity of providing a thoroughly sound scheme of electrical supply for the industrial development of the State, recommended that the electrical generation and transmission scheme should be established at Morwell, and that steps should be taken to expedite the work. The Government obtained the necessary powers, and a State Electricity Commission was appointed, and in its hands the whole of the resources of the State, from the point of view of power production, has been placed. This Commission consists of Lieut.-General Sir John Monash, G.C.M.G., K.C.B., D. Eng. (Melbourne), &c., chairman; Sir T. R. Lyle; Sir Robert Gibson; and Hon. George Swinburne. Mr. R. Liddelow is secretary, and Mr. H. R. Harper is chief engineer. By the courtesy of the Commission we are now enabled to give a description of the scheme, which it is hoped will be brought into service in 1924.

ESSENTIAL REQUIREMENTS OF THE POWER SCHEME.

The first duty of the original Board of Commissioners was to investigate and report upon the several proposals which had been placed before it. Two sources of supply were available: Brown coal or water power.

SCOPE OF INVESTIGATION.

There are large deposits of lignite or brown coal in Victoria, the two principal fields being situated in the Morwell district in Gippsland, and at Altona, 11 miles from Melbourne. Proposals had been made for hydro-electric generation from the Kiewa River at a position approximately 133 miles from Melbourne. In passing, it may be mentioned that the main black coalfield is at Wonthaggi, 86 miles from Melbourne, but it produces considerably less coal than is required by the Victorian Government Railways, which are its best customer, and the mine falls under the jurisdiction of the Railways Commissioners.

Briefly, the reason for not choosing the Altona field is that the coal winning would be much more expensive and difficult than at Morwell. The seam at the former place is 72ft. in thickness, but lies at a depth of about 350ft., and owing to possibility of ignition of the coal due to spontaneous combustion there is greater danger attached to the proposition. As the mine property is in the hands of private owners the interest on the purchase money would raise the cost of production. In these circumstances it appeared that the Altona scheme would be more expensive than the Morwell scheme.

The Commission decided that the development of the Kiewa water-power scheme should be deferred for the present, as the initial requirements of the complete scheme could not be met. It is stated that, at the outside, not more than 35,000 kilowatts would be available at Kiewa for continuous supply. In order that a hydro-electric plant may be economically successful, it is necessary that such plant should be operated almost continuously to the full capacity, but the load factor is expected to be only about 42 per cent., and until the ratio improves it is extremely doubtful whether the Kiewa scheme could be proceeded with as a sound commercial undertaking. But the Commission is of the opinion that the utilisation of water power will become economically possible, and, indeed, an essential method of any comprehensive State supply, and investigations on these lines are in progress.

After exhaustive investigations it was decided to recommend the opening up of the brown coalfield at Morwell, and the establishment of a central generating station in the vicinity of the field, with an auxiliary station in Melbourne.

MORWELL BROWN COALFIELD.

The field is situated in South-East Victoria, near the main railway line running between Melbourne and Bairnsdale and the river Latrobe.

The amount of brown coal in the area is enormous, as it is estimated that over 20,000,000,000 tons of coal are available. Intensive boring carried out by the Mines Department, over an area of approximately 1 square mile, adjacent to the site of the power-house, has proved the existence of between 120 million to 150 million tons of coal which can be won by the open-cut method of operation. These quantities are sufficient to provide for the continuous operation of a power-house with an output of 100,000 kilowatts for a period of 150 years.

The average thickness of the coal seam is 174ft., with an average thickness of overburden of 33ft.; that is to say, that each cubic yard of overburden covers on the average rather more than 4 tons of coal. The whole of the operations for winning the coal will be on the surface, and in this respect contrasts favourably with the Altona field, where deep mine operations would be necessary.

The method adopted for winning the coal is to use large revolving shovels for excavating both the overburden and the coal. Two Bucyrus shovels, having a capacity of 2½ cubic yards and 3½ cubic yards respectively, have been obtained, and are now in service. The former shovel is used for removing the overburden, and the other is used for the actual winning of the coal. The transport and dumping of the overburden is being effected by belt conveying machines, specially designed by the Commission's staff. From the shovel the coal will be transported from the open cut to the crushing and screening plant by endless rope haulage, the latter machinery being supplied by the Mead-Morrison Manufacturing Company.

Sidings have been provided on the main railway line for the transport of the coal to Melbourne and other places. The plant installed on the field provides for an initial output of 1000 tons a day, exclusive of power station requirements, and it is anticipated that the Commission will be in a position to supply raw brown coal to the public by the end of 1922.

In conjunction with the supply of raw coal, a briquetting plant consisting of five briquetting presses, giving an output of 96,000 tons per annum is to be provided. The plant has been obtained from Germany, and an engineer and five assistants have been engaged from Germany to supervise the erection and to put it into full working order. Mr. H. Herman, Engineer in Charge of Briquetting and Research, formerly Director of Geological Survey, Mines Department, Victoria, visited Europe in 1921 to ascertain the latest practice in connection with the briquetting of brown coal, particularly on the German and Austrian brown coalfields. He took samples of the Morwell brown coal, which were briquetted in Germany, with results that compared very favourably with the best German briquettes. Furthermore, the analysis of Morwell coal by German chemists indicates that it is at least equal in quality to the best German brown coal. The briquetting of the brown coal will be done without the addition of any binding material. The moisture content of a briquette will be approximately 10 to 15 per cent., and the calorific value approximately 9000 B.Th.U. to 10,000 B.Th.U. per pound.

It is estimated that the cost of winning the coal will be about 3s. per ton delivered at the power-house. If the Altona coalfield and a power-house erected there were used, it is estimated that the cost of brown coal per ton would be 7s. 1d.; and if imported seaborne Newcastle black coal were used in a power-house erected at or near Melbourne, the cost to-day would be 30s. 3d. per ton.

MORWELL CENTRAL GENERATING STATION.

The Morwell generating station has been designed in the first stage to generate a supply of 50,000 kilowatts, with provision for extension ultimately to 100,000 kilowatts, although it is possible, in view of the comparatively unlimited supplies of brown coal, to increase the plant capacity at Morwell beyond this figure should it become advisable at a later date.

The site chosen for the power-house is a piece of elevated land south of the river Latrobe and west of the present open cut. Under the worst conditions of drought and temperature it is estimated that the river will be capable of supplying sufficient condensing water to enable the power-house to generate about 40,000 kilowatts without recourse to any special cooling arrangements. As the State Rivers and Water Supply Commission of Victoria has been making an investigation for choosing a site for a weir across the river for storing sufficient water to enable the maximum use of the river flow to be made for condensing purposes, and as the construction of the weir, which is now under progress, will enable the power-house to meet a demand at times of minimum flow up to about 90,000 kilowatts at a 42 per cent. load factor, there will be no necessity to install special appliances for cooling the circulating water until the load becomes higher than 90,000 kilowatts.

Table giving List of Accepted Tenders.

Plant, &c.	Contractors.	Amount.
Turbo-alternators, condensing plant, and spare parts	Metropolitan-Vickers, Limited	£305,234
Transformers, switchgear for Morwell power station	Australian General Electric Company	£134,000
Aluminium cable	Aluminium Company of America	$365,663
Transmission towers	Milliken Bros.	£72,858
Suspension and strain insulators	Ohio Brass Company	$137,700
Synchronous condensers, transformers, switchgear, &c., for Newport terminal station	Australian General Electric Company	£228,940
Transformers, switchgear, &c., for sub-stations	Australian General Electric Company	£53,936
Telephone wire	British Insulated and Helsby Cables, Limited	£5,070

Tenders were called for the electrical plant required for the Morwell power-house in September, 1920, and the more important quotations accepted by the Commission are given in the accompanying table.

There will be five turbo-alternators, each of 12,500 kilowatt capacity, which will operate at a speed of 3000 revolutions per minute. Steam will be raised by the use of brown coal to a pressure of 250 lb. per square inch, superheated to a temperature of 630 deg. Fah. The turbines are to be of the impulse type, fitted with Bauman's multi-exhaust low-pressure blading, and also with integral condensate heaters. The condensing plant and circulating water pumps for each turbine are being made at the works of the sub-contractors, Messrs. Thompson and Co., Castlemaine, Victoria. The whole of the switchgear for the control of the generators, step-up transformers, and overhead transmission line conductors is being made at the shops of the General Electric Company, and has been designed for outdoor use. This design, while slightly increasing the first cost of the switchgear, will result ultimately in considerable economy because the costly buildings and concrete structures necessary for the indoor type will be dispensed with.

The complete steam-raising plant is being provided by Messrs. John Thompson, of Wolverhampton, the tender price being £282,318. It will comprise twelve water-tube boilers, each capable of evaporating 70,000 lb. of steam an hour, fully equipped with mechanical stokers, superheaters, all operating gear, boiler mountings, galleries, chimneys, flues and dampers. The sum of £137,110 will be spent on the manufacture of certain items which are to be made in Australia.

The construction of the buildings for the power-house has been entrusted to Redpath, Brown and Co., Limited, of Glasgow, at a contract price of £114,755. This price includes the complete manufacture, construction and erection in place at Morwell, comprising the whole of the structural steel work for the turbine room and boiler-house, and all steel floors, ladders, railings, boiler bunkers, roof-covering louvres, gutters, down pipes and ridging. The work of erection will be carried out by Australian workmen under the supervision of the firm's representatives.

TRANSMISSION SYSTEM.

The route of the first transmission line from Morwell will be *viâ* the north of Melbourne to the terminal station at Newport. A right of way varying in width from 110ft. to 300ft. is reserved throughout the whole distance from Morwell to Melbourne, and the necessary easements on intervening properties are being acquired.

The overhead transmission line will consist of one line of galvanised steel towers, spaced on the average about 1000ft. apart, carrying two transmission circuits, each consisting of three conductors and capable of transmitting 25,000 kilowatts. When the power-house capacity is increased above 50,000 kilowatts this line will be duplicated. The total number of towers required for the first stage will be about 600. The conductors will consist of aluminium wires built around a special steel core of high tensile strength, made to a diameter of 0.741in., weighing 2788 lb. per mile, and when in position the wires will have a minimum clearance of 25ft. from the ground. About 700 miles of this cable have been ordered.

The main transmission voltage will be kept at a pressure of about 120,000 volts. At Yallourn the current will be generated at a pressure of 11,000 volts, with a periodicity of 50 cycles per second, and step-up transformers will raise the pressure to 132,000 volts.

Parallel to the transmission line and on the same right of way, but on separate poles, spaced 250ft. apart, special telephone lines will be installed for the use of patrol men in effectively patrolling and maintaining the main line. A 22,000-volt line, which will be erected later, will supply power to the places along the route. A strip of land, 12ft. wide, will be reserved for transmission purposes, the area of the steel towers being 12ft. by 18ft.

TERMINAL STATIONS, YARRAVILLE AND RICHMOND.

Terminal stations are to be erected at Richmond, on a site already reserved for this purpose, and at Yarraville, near the present power-house Newport A, used and run by the Railways Commissioners for the electrified suburban railways, and the power-house Newport B, now being erected as an auxiliary generating station until such time as the main power scheme is completed. These two terminal stations will be tied together by means of 22,000-volt underground feeders. At these stations the 120,000-volt transmission power will be taken through outdoor type switchgear and transformers, the latter reducing the pressure to 22,000 volts and 6600 volts. Each of the transmission circuits will be connected to a 22,000-volt 15,000-kilovolt-ampère synchronous condenser, continuously operating, in order to maintain

a constant voltage at the receiving end of the transmission line.

From the terminal stations 22,000-volt underground feeders will radiate to the different sub-stations situated within the suburban area. The sub-stations will reduce the 22,000-volt pressure to either 6000 or 4000 volts as may be required by the existing electrical undertaking authorities. For the present it is intended to erect the Yarraville terminal station only.

RAILWAY FACILITIES AT YALLOURN.

A special branch line has been built from Herne's Oak, on the Gippsland main railway line, to Yallourn, a distance of 1¼ miles. Later it is intended to deviate the main line between Moe and Morwell around the Haunted Hills, thereby avoiding the steep gradients over the Haunted Hills. When the complete deviation is finished, permanent station buildings will be erected in keeping with the architectural scheme of the model township now being developed. Sidings will be extended from Yallourn to the brown coal workings.

MODEL TOWNSHIP AT YALLOURN.

Although the scheme has become known under the title of the "Morwell" scheme, the township of Morwell is about 5 miles from the site of the power-house, and it became necessary to decide upon a name for the new township to be erected for the Commission's staff. It was decided to call it Yallourn, derived from two native words: Yalleen (meaning brown) and Lourn (meaning fire).

Provision has been made for housing the staff in temporary barracks and quarters at present, where ample facilities have been made available for their comfort and recreation. Meals are provided on a co-operative basis, a manager being in charge of all catering. For the final arrangements, however, a comprehensive scheme has been drawn up for a model village.

The price at which the power will be supplied to consumers has still to receive further investigation by the Commission, who will then decide as to the charges to be made to the different areas supplied by them. It is not intended to fix a flat rate for the whole of the State; the price per unit in each district will be based on the proportion of cost of transmitting the power and the number of consumers of electrical energy in the district.

The Electricity Commission is desirous of discouraging municipalities from investing further public money in district generating plants in all cases where the advent of the main generating scheme will inevitably lead in the course of time to the disuse of such plants. In districts where there are already generating plants, it is intended that such generating stations shall be converted into sub-stations, the main transmission power being transformed down to the required pressure. In the majority of such cases a single circuit, consisting of three aluminium conductors, will be used, and the wires will be carried on wooden poles. Arrangements have already been made for such a service to be made available in the Western District of Victoria in the proximity of the railway line between Geelong and Warrnambool.

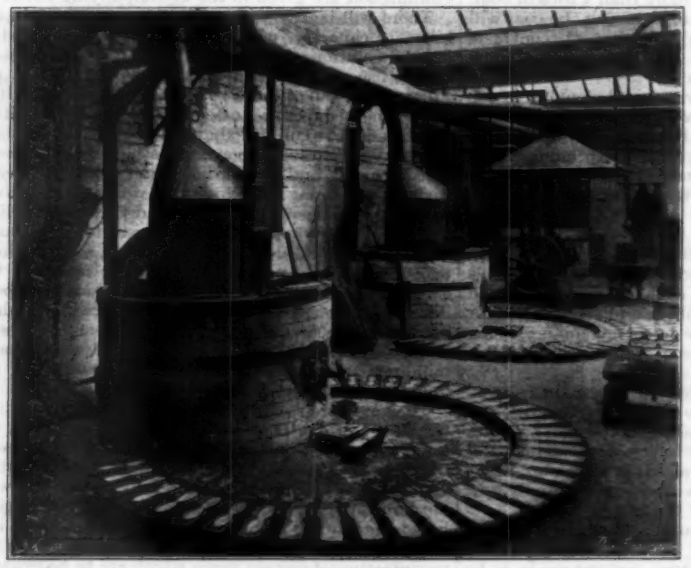


FIG. 1—CASTING WHITE METAL INGOTS

FIG. 2—7-TON MELTING POT

A London Foundry.

ALTHOUGH the migration of many old engineering businesses from the Metropolis to the provinces has left London with few foundries of much importance, there is one class of founding which must always, so long as Fleet-street retains its present character, be carried on in town. We refer, of course, to the preparation of type metal, and while that industry does not, at first sight, appear to possess any great engineering interest, we found, on visiting a type metal foundry in Blackfriars recently, much of technical interest to engineers.

The works in question, Fry's Metal Foundry, are in Holland-street, just on the south side of Blackfriars Bridge, and have developed out of a business started in 1863, by Thomas Henry Fry, for refining antimony and making type metals. Since then, however, the scope of the work undertaken in the foundry has been greatly enlarged, and the premises have extended to both sides of the road, while a new foundry shop has just been added, so that an output of from 70 to 100 tons of metal per twenty-four hours can be attained. All the alloys turned out from the works are still of the white metal type, but now include all kinds of anti-friction metals, solders and white brass, besides the printing materials originally made.

This extension of the business has, no doubt, come about to a large extent on account of the enlightened policy of the proprietor in including on the staff a number of men who combine the qualities of high technical training with good practical knowledge, and who have a natural aptitude for exploring all kinds of problems as they develop, both in the ordinary course of business and incidentally to the supply of white metals. It is, in fact, the practice of the company to undertake almost any research work concerning the metallurgy of the white metals, for anyone interested in their use, and to advise on the best alloys for specific purposes.

As an example of this investigatory spirit we might mention the little nozzle from a type casting machine which we noticed on the desk of the chief engineer at the foundry. A customer had complained that the type metal continually choked up the orifice of the nozzle, but the engineer found that the fault was in the nozzle and not the metal. The jet, not that originally supplied with the machine, was made of soft machinery steel, and the type metal, by alloying itself with the inner wall of the nozzle, gradually closed up the orifice. By substituting a cast iron jet, with which the tin would not so readily alloy itself, the trouble was overcome. Another interesting result of scientific investigation in these works has been the production of a regulus metal which is quite ductile, and is yet resistant to acids. It is thus eminently suited for lining acid chambers and similar purposes, while, unlike plain lead, it is sufficiently rigid not to creep on account of constantly changing temperature.

To revert to the works, however; the factory is in three separate sections, a refinery, the foundry proper and a die casting shop. The foundry, of which we give views in Figs. 1 and 2, is equipped with nine

FIG. 3—THURSTON FRICTION TESTING MACHINE, AND PYROMETERS FOR PLOTTING COOLING CURVES

2-ton melting pots, two 7-ton pots, and several smaller ones, some of which are intended for high temperature work. The pots are of cast iron, in brick settings, and are fired with gas from the town's mains. The weight of the pot is carried on a pier in the centre of the setting, around which there is an annular combustion chamber. The gas, mixed with air at a pressure of about 4in. of mercury, is led into this chamber in a tangential direction, so that the flame whirls round the pot, but sufficient air for complete combustion is not introduced with the gas, or the natural result would be a short, hot flame that would produce only very local heating. An auxiliary supply of air is, however, put into the combustion chamber further round its circumference, to complete the burning of the gas. By these means a very even heating effect is produced, and all likelihood of spoiling the metal by local overheating eliminated. The bath of molten metal is constantly stirred by the attendant, and although it might seem that this operation might with advantage be carried out mechanically, the management is of the opinion that hand stirring tends to concentrate the attention of the men on their work.

properties of tin and lead alloys. There is also an experimental foundry in connection with the laboratory, in which test batches are made, and manufacturing and refining problems investigated.

The die-casting department—Figs. 4 and 5—is a short distance down the street from the foundry. In it there are several automatic machines, used for producing printer's furniture, spaces and so forth, and some other, heavier, machines, designed by the Fry Company for more intricate work. The process of die-casting is, of course, too well known to the readers of THE ENGINEER for it to be necessary for us to enlarge upon its principles and applicability here; but one, at least, of the products of these works is worthy of notice. It is the bezel for holding the glass on a speedometer and measures about 3in. in diameter. It is knurled on the outside, and has a fine thread—26 per inch—inside, for screwing it on to the case. This piece is completed in one casting operation, and only requires buffing and plating to finish it. The form of the thread is astonishingly clean, considering it is produced by a casting process in a metal as hard as brass, but the makers, only naturally, do not care

In the refinery there is a coke-fired reverberatory furnace for refining old metal, dross, &c., for making castings requiring no great strength, and a gas-fired liquating furnace for removing metals having high melting points from alloys that need purifying.

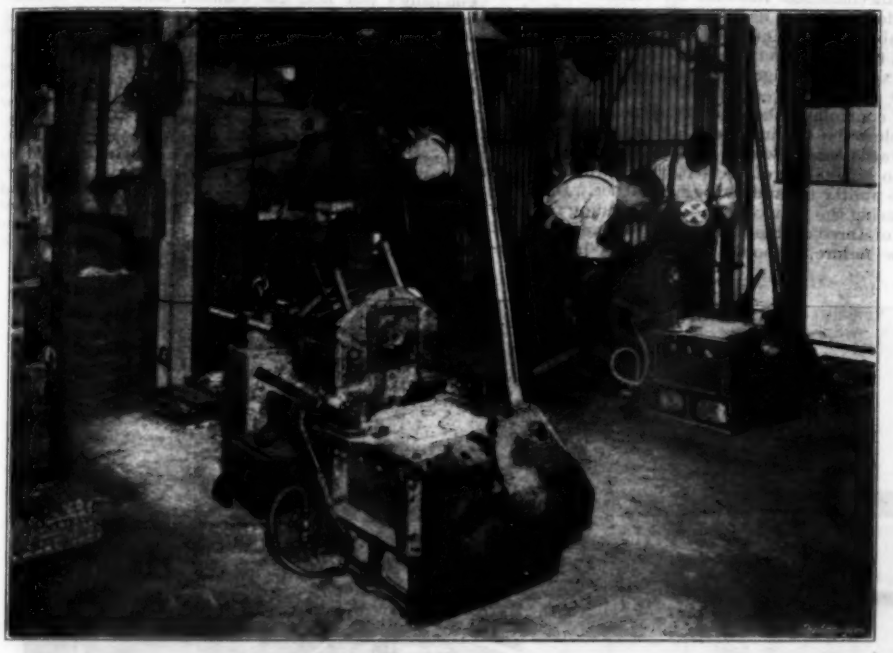


FIG. 4—TWO DIE-CASTING MACHINES—OPEN

FIG. 5—DIE-CASTING MACHINE—CLOSED

The pot has a vent at the bottom which is controlled by a valve, and through which the metal is drawn as required.

In casting ingots the moulds are arranged in a semicircle on the floor in front of the furnace, as shown in Fig. 1. The metal coming from the pot falls into a little basin and flows under a weir, to skim off any remnants of dross, and is led by a radial spout into the moulds. A man moves the spout from mould to mould as required, and it was noticeable how skilfully he managed to do this without spilling the metal on the floor. The metal is poured at the lowest possible temperature and cools quickly in the moulds. The ingots are knocked out and taken away to store by an overhead electric transporter.

Great care is taken in making up the alloys not to mix directly metals having widely different melting points, and for this reason the high-temperature furnaces already referred to have been installed, so that the metals can be separately melted and alloyed together by stages.

There were in the foundry, on the occasion of our visit, several portable melting pots of a type which has been evolved by the Fry Company for gas firing. These pots are made in three sizes, for 3 cwt., 6 cwt., and 10 cwt. of metal, and are of cast iron, mounted in an asbestos-lined sheet steel casing. The molten metal is drawn from the bottom of the pot through a spout that is controlled by a plug operated by a hand wheel at the top. There is a special form of burner that works with gas at ordinary mains pressure, and is so economical that a ton of metal can be melted, according to the makers, with 700 cubic feet of gas. The products of combustion are led across the top of the pot on their way to the chimney in order to protect the surface of the molten metal with a non-oxidising atmosphere, and to assist in keeping the top of the bath hot.

On either side of the foundry there are the offices and the research laboratory. In the laboratory there is the usual chemical equipment for metal analysis, together with pyrometers for determining the cooling curves of alloys, a Thurston machine—see Fig. 3—for finding the coefficients of friction of bearing metals, and a micro-photographic camera. A large amount of the work done in this laboratory is the routine testing of the batches of metal passing through the foundry, to check their composition; but quite a large proportion is research into the

to disclose the design of the dies used in its production. The dimensions of this piece are accurate to within 0.002in.

In an upper part of this department there is an exceedingly interesting machine by means of which the spacing leads used by printers are produced continuously by a casting process. The strip is passed between sets of fixed knives which trim off any fins that may be formed on the edges, and passes on to a set of grooved rolls. These rolls are set to produce the exact thickness of lead desired, and are followed by another pair of rolls running at a slightly higher speed to give a burnishing effect. Finally the strip is run out on a long table, where it is inspected and cut off in lengths by a girl with a guillotine.

The rolling of these leads naturally temporarily softens them, as compared with those produced by casting and machining, but they are more tough and flexible, while ageing gradually restores their hardness, so that the Brinell test shows no more than one point of difference between the cast and rolled condition. The same machine is used for the production of ribbon and blow-pipe solders.

On the same floor as the lead-casting machine which we have just described there are the electro-plating and polishing departments, which need no comment. Downstairs there is a machine shop equipped with all the appliances necessary for the production of the intricate dies used in the die-casting department. In view of the fact that it is necessary to keep the temperature of metals used in die-casting steady within narrow limits—in fact often within 5 deg. of a fixed temperature—the machines in the foundry are all equipped with electrical pyrometers, the leads from which are taken to a central point where an indicator can be plugged into any circuit.

Another novel and interesting machine in the factory is one used for making the lead wool used for caulking into the joints of water pipes. The molten lead is run into a trough with fine perforations in its bottom. The streams of lead coming from these holes drop on to a rapidly rotating drum which projects them on to a travelling band. The lead solidifies before it reaches the band, and is carried forward to the end of the machine, where it is cut off in bunches and twisted up into hanks ready for use. This material is said to be better than the shredded type of lead wool as it is in the cast condition and thus harder than that made from rolled lead.

Air Conference.

No. II.*

AT the afternoon session on February 7th the chair was taken by Sir W. Joynson-Hicks. The Chairman, in opening the proceedings, made an appeal to the Cabinet not to attempt to practise economy at the cost of stinting research work in aeronautics.

Professor Bairstow said that the principal subjects inviting attention at the present time were safety and reliability in the air. The weak point was the absence of the necessary facilities for full-scale research, and it was gratifying therefore to learn that the Air Ministry intended to build special aeroplanes for experimental work. This step had been taken on the suggestion of the Aeronautical Research Committee. For the first time in the history of aeronautics aeroplanes would be available in which the spare load would consist of instruments designed to increase the efficiency of the experimental work. He was glad to say that the arrangements for model testing were now very complete, and although the cost of these tests was comparatively small, the value of the work was very great. One example could be quoted from tests on seaplanes; it was found in three instances from the model tests at the National Physical Laboratory that the design which was to have been adopted was faulty, and that the machines would have failed in service. There were, of course, discrepancies between the behaviour of a model and a full-scale machine, but the differences were largely concerned with the effect of wind and waves on the seaworthiness of the machine. Work on many aeronautical problems was largely experimental; very little could be done from a consideration of first principles. Not only in connection with materials, but in many other matters connected with design and structure it was necessary in the field of aeronautics to strive for a greater degree of refinement than in any other branch of engineering. Quite small defects, such, for example, as the failure of the jet of a carburetter, might lead to the troubles associated with a forced landing. The obvious remedy, such as an improved type of carburetter, was not always the real line of progress; it might be a sounder policy to make a study of suitable fuels for air engines.

Commander Bird dealt with the controversy between boats and floats. Both types—flying boats and seaplanes—would, he thought, always have their special uses, but there were many who maintained that one or the other type would be developed to a high degree of efficiency for all purposes. Until now designers had lacked the aid which would be given by tests under varying conditions of full-scale models. The seaplane had not had the same chance to develop as the aeroplane. On the subject of the criticisms of the boat type, its disadvantages had been exaggerated. The difficulty arising from the high centre of thrust had been overcome in machines recently built. Difficulties were certainly not greater with the boat than with the float type, and the risk of total

* No. I. appeared February 9th.

loss was less with the flying boat. His own view was that the more serious problems were connected with the handling of the machines rather than with design, and it was necessary to give the greatest possible attention to the training of the crews. It was unfortunate that the engines fitted to seaplanes were as a rule identical with those used for aeroplanes, and he would suggest that designers and builders ought to give attention to the quality of water-tightness, particularly in connection with the air intake, to prevent spray obtaining access to the carburetter.

Sir Richard Glazebrook emphasised the need of fundamental research into the principles underlying the science of aeronautics, and drew attention to the paper read by Mr. Baker, the superintendent of the Froude tank, at a recent meeting of the Royal Aeronautical Society. Mr. Baker pointed out how necessary it was that further experiments on seaplanes should be made in advance of the construction of new types of machines. There was still profound ignorance of the fundamental laws of aeronautics, and he was glad to see that at the next meeting of the Royal Society papers were being presented on this subject. Reference had been made to the control of aircraft at low speeds. The principles governing longitudinal stability had been known for some time past, and work which had been in progress at the National Physical Laboratory had given the values of hitherto unknown derivatives, and completed the data for the determination of the stability of aeroplanes. It should now be possible to secure the control of aircraft at low speeds, and arrangements were being made to test the accuracy of the results which had been obtained. An important question had been raised in the morning discussion. It had to be admitted that there was a lack of knowledge of the proper type of machine for long-distance commercial work. That question had received attention by the Research Committee, and certain recommendations had been made which would enable the necessary experimental work to be done. He questioned whether, in connection with airships, more research work was not required before real progress could be made. Very little was yet known of the character of the pressures and forces to which a large airship was subjected when in flight. It was necessary that this question should be investigated before a service of the kind suggested by Commander Burney was started.

Major F. M. Green disagreed with the statement in one of the papers that of the total cost of flying the cost of fuel was more than half. It was a much lower percentage than that. On the subject of gliding experiments, he thought it was more difficult to work out full-scale results from gliders than by any other method. Wind channel model work had now reached a stage when much more faith was felt as to the value of the information than was the case in the past. It was preferable to continue work of that character than to experiment with large-scale gliders.

Commander Holden Richardson (U.S.A.) referred to some of the points raised in Mr. Fairey's paper. He differed from Mr. Fairey in some respects, but was in concurrence with the general preference expressed for the boat type as offering the best opportunity for commercial work. More research work was clearly necessary, and following that, tests under service conditions.

General Bagnall Wild commented on the affinity between problems in automobile engineering and aviation. There was a much closer relationship between the air engine and the lorry engine than was generally understood, and he thought it would be a good thing to bring about a closer co-ordination between the various institutions dealing with aeronautical questions and the Institution of Automobile Engineers.

Professor Melville Jones said that in the various papers which had been read great emphasis had been placed upon the question of safety. It was satisfactory to know that extraordinarily good results had been obtained from the point of view of safety in the past year, although air travel had not yet reached the same degree of immunity from accidents as railway travel. Safety at minimum speed was one of the most important questions in aeronautics. The higher the minimum speed was made the lower would be the resistance at high speed and the smaller the machine, two factors which tended in favour of economy in operation. Designers had to decide the question of minimum speed, therefore, from an economic standpoint. The economy which resulted from an increase in the minimum speed could be easily calculated, but it was not possible to place a precise value upon the factor of safety, and there was a natural tendency to attain the economy which could be calculated. That meant in many cases a higher minimum speed than was desirable in the interests of safety, and he suggested that in the interests of the industry as a whole a definite decision should be made on the safety and minimum speed question. For safety requirements the minimum speed must be less than 50 miles per hour, and it would be desirable that it should not exceed 30 miles per hour. That limit would exclude most of the existing commercial machines.

Sir Archibald Denny, speaking from forty years' experience of model experiments in connection with ship design, expressed the belief that the same degree of accuracy in passing from the model to the full-scale machine as was attained in the case of ships would be reached by those engaged in aircraft experimental work.

Mr. Handley Page agreed with Professor Jones as to the need for low landing speeds.

Sir Sefton Brancker also dealt with the subject. He deprecated agitation, believing that the real cure for risk in landing was to eliminate engine failure. A much more difficult problem with heavily laden machines was a rapid get-off from the ground. It must not be overlooked that from the economical point of view speed was of the utmost importance. The Handley Page machines were low-speed machines, and on some occasions they had been unable to reach Paris within the four hours, which was the time limit for subsidised services.

Sir Geoffrey Salmond said that many things yet remained to be done in the field of research. A satisfactory gear for multi-engine machines had not yet been produced, nor had success been achieved in the investigation of the aerodynamical qualities of six wings, although some results in both cases might be expected at a comparatively early date. Another subject still being investigated was the all-metal aeroplane, which, in the light of existing knowledge, was an uneconomical machine for commercial work. A great deal had been heard on the question of safety and reliability. One of the things which had to be achieved to assure safety was the ability to land in a confined space. To a great extent the safety of flight had now been achieved, and if a method could be found of controlling the stability of aeroplanes when flying below the stalling speed, an important further step towards safety would have been taken. With regard to reliability of service, this turned largely upon the ability to land in foggy weather. Developments during the past year had been tending towards the use of three-engined machines to limit the risk of engine failure, although failures had been practically non-existent during the past year. He had been much impressed by what had been said as to the effects on the efficiency of the pilot of eliminating noise. Some progress had been made in this direction; noise from the exhaust had been eliminated, but the noise made by the propeller and that of moving parts of the engine could not yet be prevented. The question of parachutes had been raised particularly in connection with service machines. The investigation of that subject had never been suspended, but the parachute of 100 per cent. reliability had not been evolved, although one of 95 per cent. reliability was now available. Three types of parachute were at present under test. It had been intended to carry out trials with float and boat types of machines, but unfortunately there had been a fatal accident with one of the machines, and it had been necessary to defer the experiments.

Mr. Calthrop, intervening, said that eighteen months ago he submitted two entirely new types of parachute to the Air Ministry, but was told that the Ministry had neither money nor machines to carry out tests on them.

Sir Geoffrey Salmond said that parachutes would be definitely adopted when a satisfactory type was available, but he would point out that there were great difficulties in releasing parachutes from high-speed machines.

Mr. Calthrop replied that one of the new parachute designs was intended for use during flights at high speed.

Colonel A. Ogilvie also replied briefly to the discussion. He said that when new commercial aeroplanes were being ordered, instead of tenders being invited by the Government, it would be better that the transport firms should deal direct with the aircraft manufacturers.

Mr. C. R. Fairey agreed with what had been said in the course of the discussion, that probably both the float and boat types of machine would survive. Commander Bird had referred to the difficulty created by a high centre of thrust. That difficulty could be overcome. The safety of a machine at sea depended to a very great extent upon whether the engine was running or the machine was adrift, and the designer was forced to make a compromise between these two possible conditions.

The Conference terminated with vote of thanks to Lord Mayor and the City Corporation for the use of the Council chamber during the meeting.

Abstracts of Mr. Fairey's paper on "Seaplanes" and Colonel Ogilvie's paper are given on pages 174 and 184 respectively.

New Landing Stage and Wharf at Gosport.

FOR some years the Urban District Council of Gosport and Alverstoke has been desirous of improving the approach to Gosport from Portsmouth. The only direct means of communication between the two places is across Portsmouth Harbour. There are three lines of ferry boats, viz., two between Portsmouth Harbour Station and Gosport Hard, and one between the Floating Bridge Company's pier near the Camber, some little distance down the harbour, and that company's small floating stage on the Gosport side. The landing on Gosport Hard was a troublesome and, in bad weather, apt to be a somewhat risky proceeding. The floating bridge before referred to caters for vehicular traffic, and for many years has been working to and fro across the harbour and has carried on successfully a very useful and necessary work.

In 1918, powers were sought from Parliament to borrow money for improvements at and near the Gosport Hard to facilitate the embarking and landing of passengers, and for other purposes. The necessary Act of Parliament was obtained in December, 1919, and a contract was let for the construction of the work in August, 1920. The improvements included the reclamation of a considerable area of foreshore in front of Beach-street, High-street and Castle-row—see the accompanying drawing—the construction of a floating landing stage and the approach thereto by means of a road across the reclamation, and by a movable bridge to accommodate itself at the sea end to the rise and fall of the landing stage with the tide. Further northwards, just beyond the shipbuilding works of Camper and Nicholson, Limited, a reinforced concrete wharf, which is approached by a channel dredged from the deep water adjoining, has been erected to take the place of the quay which has been absorbed in the reclamation before referred to.

THE NEW LANDING STAGE AT GOSPORT, FROM THE PROMENADE

Work was at once commenced on the driving of the necessary piling for the wharf and for the retaining wall of the reclamation. The construction of the landing stage and the approach bridge to it was also put in hand. As the permanent approach to the new landing stage covers the site of the old Hard where the passengers were formerly landed, it was necessary to provide a temporary approach while the Hard was being removed, so as to admit of the front retaining wall of the reclamation being constructed across it.

The southern portion of the retaining wall of the reclamation and a portion of the front retaining wall from its junction with the southern wall to where it meets the Hard was first completed and the landing stage then placed in its permanent position. The bridge connecting it with the shore was first temporarily erected at the south end of the landing stage and connected to the temporary approach. The latter was constructed of timber, a great part of which was subsequently used for the pile-driving of the retaining walls. The Hard was then removed, and the completion of the retaining wall proceeded with. Thereafter the permanent approach to the landing stage was formed across the reclamation, and the approach bridge was then removed to its final position.

As no interference with traffic was allowed under the provisions of the Act of Parliament before referred to, the placing of the landing stage and the approach bridge in position had to be undertaken on a Saturday between the hours of 11.30 p.m., when the ferry boats stopped running, and 9 a.m. on the following Sunday. The operation was successfully performed, and everything was ready for the resumption of traffic without the least interference on the following morning.

The method adopted for placing the landing stage and

movable bridge in position was as follows:—The bridge, which is 102ft. long by 21ft. wide and weighs complete about 44 tons, was erected on the new reinforced concrete wharf—mentioned above as being to the north of Messrs. Camper and Nicholson's works—and then skidded on timber baulks on to four timber piles—fitted with cross-heads—driven specially for the purpose in front of the wharf, in such a position and at such height that two barges, 62ft. 7in. by 21ft. by 3ft. 2in. draught (light) could be floated between the piles and underneath the bridge, so that when the tide rose they might take the weight of the bridge and lift it clear of the piles, to enable it to be towed out into deep water and moored, ready for being towed to the Hard for fixing in its position there. The end of the bridge was lowered on to the rocker plates and bolted down, and the sea end at once lowered on to the roller paths fitted on the landing stage. Immediately the landing stage was brought into use, work was commenced on the removal of the old Hard and the erection of a temporary timber staging along the line of the new retaining wall forming the front of the promenade, for the purpose of driving the reinforced concrete piles of which the retaining wall is constructed. When the temporary staging was sufficiently advanced the driving of the concrete piles was proceeded with, and this, and the construction of the necessary strutting and bracing, was completed in November, 1922.

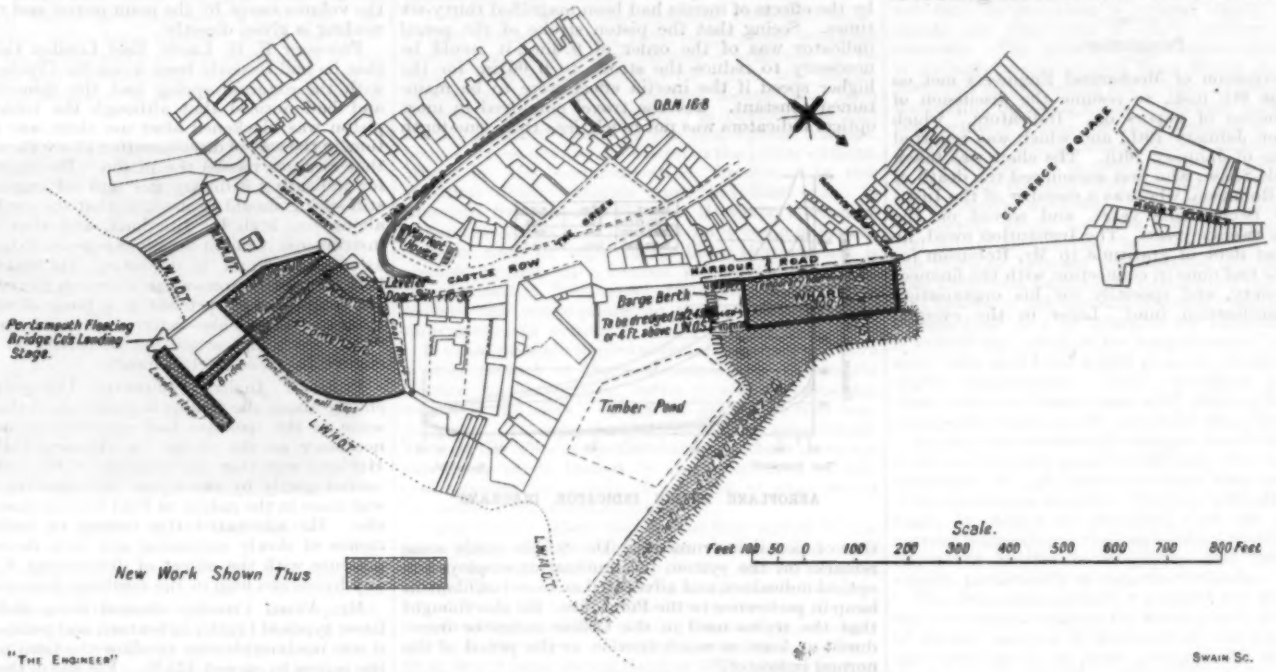
Meanwhile, the filling-in behind the retaining wall was commenced and followed that work as it was completed in sections. The filling-in material was obtained from the Ramparts, which formerly practically surrounded Gosport on the landward side. The material was excavated by means of a steam navvy, and loaded into steam tipping lorries, by which it was conveyed to the site behind the retaining wall, a distance of about half a mile, and tipped. The quantity removed from the Ramparts for this work, and for the new wharf referred to earlier, was about 32,000 cubic yards. When the filling was sufficiently advanced, the permanent road approach from the High-street to the front retaining wall was constructed, and during this period a reinforced concrete pier to support the fixed end of the moving span of the bridge in its permanent position was constructed.

These works being completed, all was ready for the removal of the two spans of the bridge into their permanent positions, and this had to be done during the night, as in the case of placing the bridge in its temporary position. The moving over of the two spans of the bridge was a much more difficult operation than placing them in their temporary position, owing to the difficulty of lifting the spans on barges at any other time than high water, and in the limited time for this operation. It was therefore decided—if it were found to be possible—to obtain the use of the floating crane at Portsmouth Dockyard for the purpose, so that the removal of the bridges from their temporary to their permanent position could be carried out with certainty in the limited time allowed. This crane was, of course, capable of easily dealing with the weight required and of working at a sufficient radius. On the circumstances being explained to the Admiralty officials concerned, they expressed their willingness to grant permission to use their crane for this purpose, and we are desired to state that the engineers and the contractor would like to take this opportunity of expressing their high appreciation of the assistance rendered. The floating crane was brought alongside the landing stage about 11 p.m., and was then manœuvred into position behind the landing stage, a very difficult operation, as there was a strong tide running, and only a clearance of 18in. on either side between the sides of the pontoon carrying the crane and the new landing stage on the one side and the pier for supporting the fixed end of the moving span on the other.

The spans of the bridges had to be temporarily strutted to obviate any risk of damage due to being lifted by means of slings. The lifting slings had all been fixed ready previously to this, so that when the crane was in position, and the last ferry boat had discharged her passengers, all was ready for moving over the fixed span, which was effected by about midnight, and by 2 a.m. both the fixed and moving spans on the bridge were resting in their final positions and the floating crane had returned to her mooring in the Dockyard.

The new wharf is 300ft. long by 100ft. wide, and it was wholly reclaimed from the harbour. Its design is similar to that of the retaining wall of the promenade, and it was constructed of 13in. by 13in. reinforced concrete piles, driven at 10ft. centres on a batter of 1 in 12, the intermediate spaces being filled with 15½in. by 8in. reinforced concrete sheet piles also driven to the 1 in 12 batter. This piling is anchored back to 13in. by 13in. reinforced concrete piles and walings, the front and anchor piles being connected by 13in. by 13in. reinforced concrete beams. The filling-in behind the piles was obtained from the old Ramparts, as in the case of the filling for the promenade. For a width of 20ft. along the front of the wharf the surface is covered with sett paving taken from the surface of the old Hard. The remaining surface of the wharf is covered with clinkers well rolled, and a top coating of gravel.

A crane road runs the whole length of the wharf, and on it operates a 3-ton electric crane made by Booth Brothers, Rodley, Leeds. We understand that the provision of these facilities for embarking and landing passengers has proved successful in every way, and that the new arrangements are much appreciated by the users of the



MAP SHOWING POSITIONS OF NEW LANDING STAGE AND WHARF

erection of this bridge on the wharf occupied about three weeks. The fixed span at the Hard was erected in September, 1921, ready to receive the shore end of the movable bridge. This span is 31ft. 6in. long by 21ft. wide, and weighs about 7 tons. Its shore end was fixed on the front retaining wall, and the seaward end placed on temporary timber trestles.

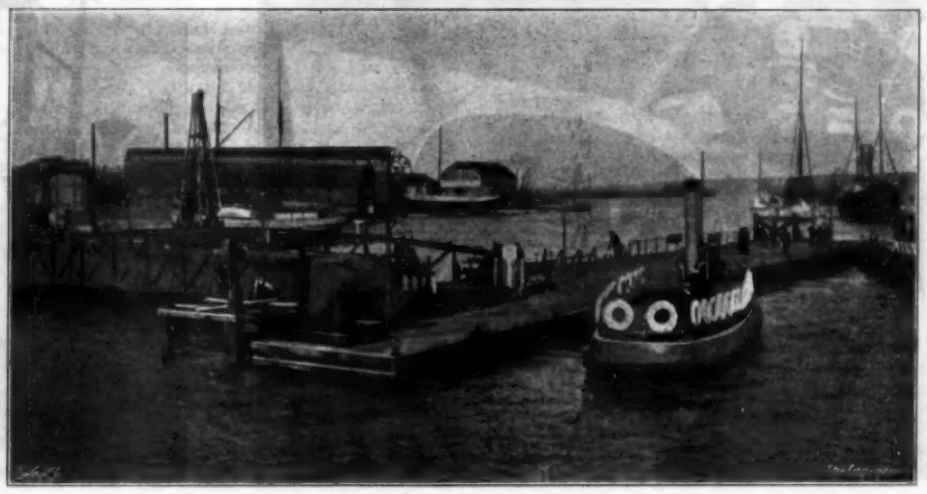
The floating landing stage, which is 200ft. long by 30ft. wide, consists of a series of riveted steel pontoons, connected together by girders bolted on top and supporting a decking of timber work. There are twenty-two pontoons in all, all of them being 8ft. in width. Seventeen are main pontoons 29ft. 6in. in length, and there are three additional pontoons 17ft. 6in. long at the back of the landing stage to take the weight of the outer end of the movable bridge, and a shorter pontoon at each end of the landing stage to afford space at the inner corners for the piled dolphins which maintain the landing stage in position.

The pontoons, which each weighed from 5 to 6 tons, were delivered by rail from Darlington, riveted together complete. On arrival at Gosport they were carted to the wharf, lowered by steam crane into the water, towed out to a convenient berth in deep water in Portsmouth Harbour, where they were assembled by riveting up the longitudinal girders and fixing the timber decking. This work occupied about three months.

When the movable bridge and landing stage were assembled it was necessary, as already stated, to choose a suitable tide on a Saturday night and Sunday morning for placing them in position, and the night of December 3rd-4th, 1921, was decided upon. Preparations were made to float the bridge off the timber piles on the rising tide on November 30th, but the weather was too rough. This operation was, however, successfully accomplished on December 1st, and the bridge, supported on the two barges, was towed off and moored to an Admiralty buoy in Portsmouth Harbour by permission of Captain C. Tibbits, R.N., King's Harbour Master. The mooring to this buoy had to be done at short notice, as the wind proved too strong to allow the barges and bridge to be anchored close to the landing stage, which had been the intention.

On December 2nd the landing stage was towed from the berth where it had been assembled to an anchorage in the vicinity of its permanent position at Gosport Hard, and on December 3rd the bridge was also towed down near the stage and moored off Messrs. Camper and Nicholson's yard. During the day of the 3rd all preparations were made, and directly the ferry boats had ceased running at 11.30 p.m., the bridge resting on the barges was floated into its approximate position on the rising tide just before high water. The weight of the shore end of the bridge was taken by heavy shear legs, furnished with large blocks and tackle—which were mounted on the fixed span. The landing stage was then immediately warped into its position and secured between a heavy timber dolphin erected for the purpose at the north end of the stage, and a small pontoon, which was previously used by the ferry boats, at the south end. This small pontoon has since been removed, and the south dolphin erected, the landing stage now being attached to the dolphins both north and south.

The weight of the sea end of the bridge was then taken by shear legs erected on the landing stage itself, and as the tide fell the two barges were floated out from under the bridge. As soon as the barges were clear, the shore



THE NEW LANDING STAGE FROM PORTSMOUTH HARBOUR

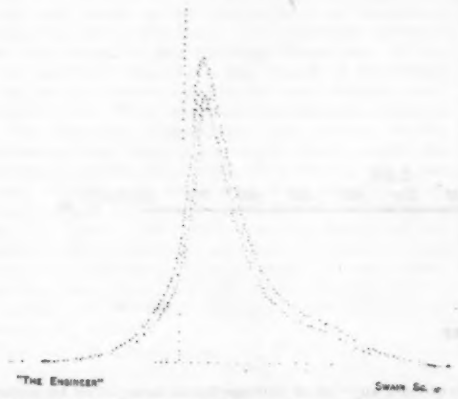
ferries. Two views of the completed landing stage are given herewith.

The works were designed by Sir John Wolfe Barry, Lyster and Partners, and were carried out under their supervision, and that of the resident engineer, Mr. George Hobbs. The contractors for the works were Messrs. John Price and Son, of Westminster, who were represented on the works by Mr. Howard Hollowday. The construction of the steel work was entrusted by the contractors to the Cleveland Bridge and Engineering Company, Limited, of Darlington.

Institution of Mechanical Engineers.

INDICATORS.

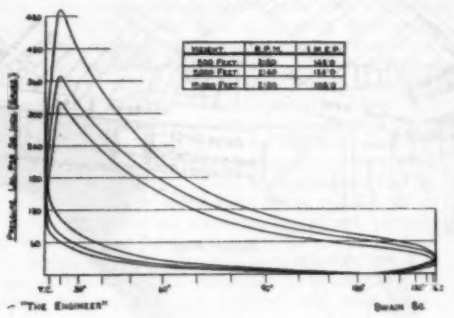
THE Institution of Mechanical Engineers met on Friday, the 9th inst., to resume the discussion of the symposium of papers on "Indicators," which was read on January 19th, and which was reported in our issue of January 26th. The chair was taken by Dr. Hele-Shaw, who first announced the death of Mr. Mark Robinson, who was a member of the Institution for twenty-nine years, and served on the Council for twenty years. The Institution owed, he said, a great debt of gratitude to Mr. Robinson for the work he had done in connection with the finances of the society, and specially for his organisation of the amortisation fund. Later in the evening



INDICATOR DIAGRAMS TAKEN ON AN AEROPLANE IN FLIGHT

Dr. Hele-Shaw had to leave the meeting for another engagement, and Sir John Dewrance, the President-elect, then took the chair.

The discussion of the papers was opened by Dr. W. A. Scoble, Woolwich Polytechnic, who said that there was a considerable gap between the pencil type of indicator and the optical form, which had not so far been bridged over. He had recently been engaged on the design of a new pencil indicator, which he hoped would extend the range of usefulness of that type, and had found it very difficult to effect a compromise between the different requirements. It was, in fact, generally necessary to sacrifice one desirable characteristic in order to obtain some other one. British-made indicators were not, he thought, appreciated as they should be, and their design was, in his opinion, sounder than that of any made abroad. There appeared, he thought, to be a tendency towards the adoption of barrelled pistons, but it did not seem to him to be a good policy, as any angular movement of the piston-rod affected the clearances, and if there was any grit in the cylinder it might jam hard between the piston and cylinder wall. Mr. Pendred had criticised the outside spring on account of the increase of inertia which it involved, but Dr. Scoble thought that it was well worth the advantage gained by getting the spring away from the heated part of the instrument. He would like to have some check on the high-speed indicator, as there really was no assurance that the records were correct, and although he supposed that they were reasonably so they were none too accurate. The ordinary pencil indicator was, no doubt, quite accurate for speeds up to some 300 revolutions per minute, but it should be borne in mind that when the speed was increased to 2000 revolutions per minute, the difficulties caused by the effects of inertia had been magnified thirty-six times. Seeing that the piston stroke of the pencil indicator was of the order of 0.3in., it would be necessary to reduce the stroke to 0.001in. for the higher speed if the inertia effect were to be maintained constant. Yet the travel employed in most optical indicators was not much less than one-tenth



AEROPLANE ENGINE INDICATOR DIAGRAMS

that of pencil instruments. Dr. Scoble made some remarks on the system of illumination employed in optical indicators, and advocated an over-run filament lamp in preference to the Pointolite. He also thought that the stylus used in the Collins indicator introduced at least as much friction as the pencil of the normal indicator.

Captain H. Riall Sankey remarked that although the symposium of papers had been presented more or less in connection with the Institution's forthcoming trials of marine oil engines, he hoped the discussion would bring some light to bear on the subject of indicating heavy oil engines running at comparatively low speeds. In the classical trials carried out by Willans, the Crosby type of indicator was used, and when worked at a speed of 400 revolutions per minute was accurate to within 1.0 per cent. That was, of course, when indicating a steam engine, but in the case of the oil engine the shock of the explosion introduced complication, and the errors amounted to 2 or 3 per cent.

Mr. L. Pendred introduced some further instruments, which had been added to the collection on exhibition at the Institution, and which now included the Dalby-Watson indicator with the water-cooled diaphragm. He also showed a lantern slide made from the celluloid "card" of the Collins indicator. Mr. W. J. Still also exhibited a number of slides of cards taken by the Dobbie-Hopkinson optical indicator.

Mr. W. J. Stern, Air Ministry Laboratory, made some sketches on the blackboard to show the construction of an instrument which actually takes advantage of inertia in its operation. It gives only, but directly, an indication of the mean effective pressure. The piston of a small cylinder in communication with the main engine cylinder under investigation is connected with a lever, and is opposed by a spring. The moment of inertia of the lever is deliberately made large, by means of a fly-wheel, so that its period of oscillation is large as compared with the period of the engine, say, 2 or 3 seconds. The lever thus takes up a steady position, which is a measure of the M.E.P. on a time basis. In order to get the indication on a displacement basis the point where the piston-rod is connected with the lever is moved up and down in a slot in accordance with the movement of the main piston. The result is that the moment of the force exerted by the pressure on the lever is always proportional to the volume swept by the main piston and the desired reading is given directly.

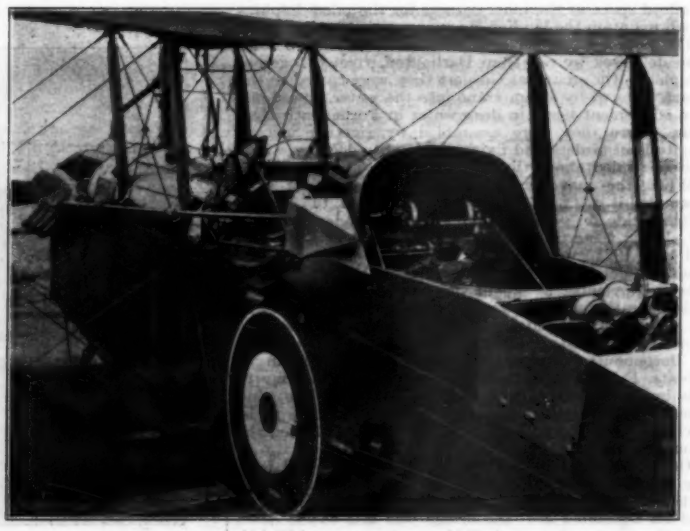
Professor E. H. Lamb, East London College, said that he had recently been using the Crosby indicator with the external spring and the spherical piston, and had noticed that although the bottom of the piston was blackened after use there was no indication, in the way of discolouration above the centre line, that any gas passed the piston. He suggested that for indicating ordinary gas and oil engines a very stiff spring should be used, so that the card would be about ¼in. high by 1in. long, and that in optical instruments it might be advantageous to use a piston as small as 2 mm. in diameter. He had found the best form of illuminant an over-run motor car lamp set behind a hole pricked in a piece of copper foil. Professor Lamb also referred to some experiments which are being carried out in Russia on indicating engines by piezo-electric means.

Professor Inglis, Cambridge University, spoke chiefly about the Collins indicator, and thought that some of the speakers had over-estimated the force necessary at the stylus for drawing the diagram. His idea was that the material of the celluloid was moved gently by the stylus, and that the resistance was more in the nature of fluid friction than anything else. He advocated the testing of indicators by means of slowly increasing and then decreasing the pressure with the object of discovering if there was any hysteresis loop in the resulting diagram.

Mr. Alfred Crossley showed some slides of the latest types of Crosby indicators, and pointed out that it was inadvisable ever to allow the total pressure on the piston to exceed 125 lb. For use in Diesel engine work he recommended the employment of a piston of ½ square inch in area.

Flying Officer C. J. Simms made some remarks as to the relative merits of the various types of indicators for laboratory and workshop use, pointing out that in the former case it was generally necessary to get only one cycle on the diagram, whereas in the shops a nearer approach to normal working conditions was wanted, and the instrument which indicated the mean of several cycles was more appropriate. It was possible with Dr. Mahler's micro-indicator, which has a 0.5 square centimetre piston, a spring in tension, and makes the diagram on blackened glass, to get the white line as narrow as 0.01mm. With regard to the piezo-electric method of indicating, it suffered from the great disadvantage that it was very difficult to isolate the electro-static plates from the heat of the engine which had a serious effect on their action.

Mr. E. T. Vincent commented on the bulkiness of the optical form of indicator, which, he thought would preclude its use in confined spaces, such as the engine-room of a submarine and many other vessels. For speeds up to 400 revolutions per minute he thought that there was little to choose between the pencil and the optical indicator. He had taken similar cards with both instruments, and when they were superimposed found that they practically coincided, that is to say, within 10 lb. in 600 lb. He



VIEWS SHOWING R.A.E. INDICATOR FITTED IN THE REAR COCKPIT OF A D.H. 9A AEROPLANE

also gave some hints on the proper handling of indicators.

Mr. A. E. L. Chorlton sketched on the blackboard a peculiar form of diagram, which he had once taken off an engine, that had a remarkable waviness on the compression curve. It appeared as if these vibrations resulted from exhaust pulsation, and he wondered if detonation might sometimes be accounted for by a continuation of these vibrations right through the compression stroke to the time of ignition.

In replying to the discussion, Mr. W. Sydney Smith said that they had been successful at Farnborough, on February 3rd, in indicating an aeroplane in flight, when Mr. Wood took some diagrams from the 400 horse-power Napier-Lion engine of a D.H. 9A. Mr. Wood showed some lantern slides, which we reproduce, of the arrangement of the instrument in the rear cockpit and the diagrams obtained. It will be seen that the indicator is driven off the engine cam

R.A.E. INDICATOR ON AN AEROPLANE

shaft by a universally jointed shaft, and that the balance valve shown in this view is fixed on the second cylinder. The two diagrams show plainly how the power developed by the engine falls off with increased altitude, while the table on one of them gives the revolutions per minute and the mean effective pressures. Mr. Collins also replied briefly, and said that he had tested his indicator for hysteresis. Neither friction nor hysteresis resulted in a greater error than 1 per cent.

The Electrification of the German Railways.

THE following is an excerpt of a report of meetings held at Hirschberg on December 15th–17th, 1921, of the sub-committee appointed to consider electric traction on main-line railways by the Committee on Technical Affairs of the Association of German Railway Administrations. At the meeting were representatives of the various German, Austrian, Hungarian, Dutch, and Swiss railways. The report contains much useful information on several of the most important questions concerning railway electrification. These are as follows :—

1. The question of the system.
2. Discussion of the question of the system.
3. Proposed standards.

THE QUESTION OF THE SYSTEM.

Introductory Remarks on German Railways : Historical.—The representative of the German Federal Railways stated that before the German Empire took over the State Railways on 1st April, 1920, Prussia, Hesse, Bavaria and Baden had in 1909 begun to adopt electric traction on long-distance railways, and in 1912–13 these three railway administrations agreed to standardise single-phase current at 16⅔ cycles with an overhead conductor pressure of 15,000 volts. Early in 1921 it was decided to reconsider the question of the system in light of the experience of a decade. While the neighbouring countries, Switzerland, Sweden and Austria, had also adopted the single-phase system, success had been obtained in America with the 3000-volt, continuous-current system, and France and Great Britain had decided in favour of the 1500-volt, continuous-current system. In addition the supply question had to be fully considered. Before the war special traction generators were employed, but during the war large three-phase stations were built, which afterwards could not be fully loaded.

After considering all *pros* and *cons* the Federal Railways decided to retain the single-phase system. In arriving at this conclusion in February, 1921, the Minister of Transport had the assistance of expert advice from all quarters, including designers of motors and high-voltage switchgear and representatives of the telegraph administrations. The opinion in favour of the single-phase system was unanimous.

Supply.—With regard to long-distance transmission it was stated that no existing transmission line in Germany is dimensioned for supplying large railway undertakings ; even the Bavarian scheme is not in a position to do so on a large scale. It was therefore considered to be better to choose for the new transmission lines the system adopted for the railways. Moreover, single-phase lines are cheaper than three-phase lines, because of the shorter poles and fewer conductors. The smaller number of insulators enhances the factor of safety. The sub-stations also need only two-thirds as many switches and busbars. Though single-phase generators and transformers are dearer, with stations a long way apart it is the extra cost of the lines which is decisive. Further, a larger pressure drop, and therefore a less costly line, is permissible for railway than for general supply. There is also the possibility that for general purposes single-phase transmission at low frequency may some day be found to be the most economical for large powers and long distances.

Interference with Communication Circuits.—Interference troubles, arising from single-phase overhead conductors, have caused increased attention to be paid to continuous current, with which the disturbances are less serious. Several means have been adopted to reduce or nullify the electrostatic and electro-magnetic effects of the single-phase current. Some of these devices are placed in the power circuits, others in the communication circuits. In this direction much valuable work has been done in America, Sweden and Silesia. However, it must be remembered that it is unsafe to have communication lines so near to high-voltage lines that contact is possible in case of a broken wire. Removing the communication lines away from the danger zone renders the single-phase no worse than the continuous-current system.

It is not possible to give actual data which will give a clear picture of the economical side of electric traction for these lines, owing to the experimental nature of the work. A definite saving in coal consumption, however, has already been established. Thus on the Silesian electric railways, where there are still many trains hauled by steam locomotives, the coal consumption is only 60 per cent. of what would be needed with steam alone.

Local Lines.—Here the system best suited to the particular conditions should be chosen. The most important case in Germany is the railway system around Berlin. Until recently single-phase was preferred there because of a uniform system on the one hand and the possibility of using the existing passenger stock on the other. The rapid increase in traffic—40 to 50 per cent. during the year 1921—however, had rendered it essential to acquire new rolling stock; and since the continuous-current system has been found to permit the maximum possible increase of traffic, this system has been chosen. An exhaustive investigation also showed that under present conditions continuous current at moderate pressure would be more economical than single-phase current for the Berlin lines.

The Berlin Railways.—The representative for the Berlin Railways stated that for electric traction on the urban, ring and suburban lines the continuous-current system with third rail at 800 volts had been chosen. This result was reached by comparative investigations. The traffic is very dense, reaching forty trains per hour in urban districts, with stops not exceeding 25 sec. This entails a braking retardation of 0.5 m. per sec. per sec. and a starting acceleration altogether too great for either steam or electric locomotives with the long heavy trains in question. Consequently motor coaches alone become suitable. Motor coaches for single-phase are much more costly than for continuous current, and the extra cost of the large number of requisite motor coaches proved decisive for the choice of system. Although the installation and conversion costs are much greater than with single phase, continuous current has the advantage in point of economy and upkeep.

Energy at 100 kilovolts will be delivered at Stralau-Rummelsburg and Eichkamp, at the east and west of the Berlin ring, and there transformed down to 30 kilovolts, at which pressure it is supplied to the converter stations. The track pressure is to be 800 volts continuous, and the current is to be collected from the bottom of the rail.

The Austrian Federal Railways have decided to employ single-phase current at 15,000 volts and 16⅔ cycles. In addition to technical considerations, the fact had also weight that the neighbouring States of Bavaria and Switzerland had also adopted this system.

The Dutch Railways.—The report on the railways in Holland states that only the Rotterdam-Hague-Scheveningen line is worked electrically. Operation began in 1908, the system being single-phase at 25 cycles and 10,000 volts. When the electrification of the Amsterdam-Hague-Rotterdam line was decided upon, the question of the system was reopened and continuous current at 1500 volts was chosen as the standard system for main lines, for the following reasons :—

(*a*) Overcoming interference with communication circuits is more costly with the single-phase than with the continuous-current system—an important matter for a densely populated country like Holland, with a great number of communication lines along the railways.

(*b*) The continuous-current motor is simpler and needs less upkeep than the single-phase motor.

(*c*) With the relatively short distances in Holland the advantages of the higher pressure with single-phase are not sufficiently marked.

(*d*) With such short distances and the density of the traffic there is no great difference between capital and working costs with the different systems.

(*e*) The prospect of automatic sub-stations with mercury rectifiers tends to remove one of the chief drawbacks of the continuous-current system.

(*f*) Continuous current is more suitable than single-phase when the supply is taken from a general network.

DISCUSSION ON THE QUESTION OF THE SYSTEM.

All the railway administrations represented at the meeting, with the exception of the Dutch, had decided for the single-phase system. In discussing the merits and demerits of continuous current it was pointed out that in providing a general supply of electric energy the chief aim of every country should be economy. The 3000-volt continuous-current system is strongly recommended from North America. A 3000-volt supply would not be easy to control with the fluctuating demands made in German railway operation, while a motor for that pressure is out of the question. Working several motors in series becomes impracticable. It is noteworthy that Great Britain, France and Holland have decided in favour of 1500 volts continuous current. The section of the overhead conductor, which for 3000 volts must be at least 200 square millimetres, becomes much larger and the distance between sub-stations still shorter ; so that 1500 volts leads really to the third rail. The cost and upkeep of sub-stations becomes considerable, and though that may be tolerable for suburban lines, it is out of the question for long-distance lines, where snow, dew and frost would give rise to extraordinary traffic disturbances. The conversion losses with 1500 volts are lower than with 3000 volts, because rotary converters can be used with the lower pressure.

In addition to other advantages, one deciding factor in favour of single-phase in Germany was that smaller quantities of high-grade materials were needed than with continuous current. Further, with all its advantages, it cannot be conceded that the continuous current is superior to the single-phase motor. Another important matter is simplicity and reliability in supply, particularly as regards overloads.

The Swiss representative pointed out that, despite the favourable situation for water power, the economy of electric traction in Switzerland was not such that one could speak of great savings. At the moment steam was cheaper than electric traction. With coal at 80f. per ton the costs of steam and electric traction on the St. Gothard route were about equal. Economy depended largely on the service, and that at present was only about 60 per cent. of the pre-war service.

A German delegate mentioned that too little attention had been paid to the repair shop question in the past, and bad experience was obtained with private firms. Repair shops are to be erected in Breslau, Halle, Munich and Berlin.

In reply to several questions, the Dutch delegate stated that when the electrification of the Amsterdam-Rotterdam line was projected a commission of technical railwaymen was appointed to determine the system. That commission recommended the single-phase system at 15,000 volts, 16⅔ cycles, acting on the assumption that the whole Dutch railway system could be fed from four or five power stations, which would be near enough together to render high-tension transmission or transformer sub-stations unnecessary. Later considerations showed that with this solution there would be much interference with the communication lines and that consequently sub-stations would be essential. In the result continuous current at 1500 volts was adopted.

Summing up, the Chairman stated that the result of the discussion on the question of the system was that the special conditions of a given country or line might lead to different systems than the one now regarded as the best. Since, however, the great majority of the German railway administrations had decided in favour of the single-phase system at 15,000 volts and 16⅔ cycles, the sub-committee would have to devote itself chiefly to the consideration of that system and, if possible, establish uniform lines for its future extensions.

PROPOSED STANDARDS.

In the discussion of the chief questions of electric traction—system, frequency, transmission pressure, overhead conductor pressure, height of overhead conductor, clearance and width of bow collectors—the sub-committee was of the opinion that if single-phase be selected the best frequency would be 16⅔ cycles, while variations of 5 per cent. upwards and 10 per cent. downwards should be permitted in working.

The discussion led to the proposal that the two pressures of 110 and 55 kilovolts should be chosen for long-distance transmission. It was decided that the overhead conductor pressure should be 15,000 volts, with a maximum of 16,500 and a minimum of 12,000 volts. To prevent trouble with the control equipment it was recommended that all electro-magnetically operated apparatus should work satisfactorily at 10,500 volts.

ONE of the latest specifications issued by the British Engineering Standards Committee deals with piston rings for motor-car engines. Dimensions and limits are given for cylinders ranging in diameter from 2in. to 6in. in ¼in. steps, and for diameters between 50 mm. and 150 mm. in steps of 5 mm.

Indian Engineering Notes.

(*From our own Correspondent.*)

BOMBAY, January 27th.

Concrete Railway Sleepers.

THE North-Western Railway of India has made exhaustive tests of a new type of concrete railway sleeper patented by a Mr. D. H. Stent. The experiments have been made on 50 miles of main line track near Delhi, and the results have been so satisfactory that a further 70 miles of track will be similarly equipped at an early date. The new sleeper consists of two concrete blocks joined together by a tie bar, the rails being fastened by means of screw or dog spikes driven into wood plugs, specially treated and compressed, set in the body of the concrete block. Two other Indian railways are interested in concrete sleepers—the East Indian Railway, which has nearly completed a factory for manufacturing 50,000 sleepers per annum, and the Bengal-Nagpur Railway, which has acquired a licence to manufacture 300,000. Both these lines, however, have adopted the Green-Moore sleeper, a type which has been the subject of experiment on one of the main tracks near Calcutta since early in 1915.

Railway Improvements.

There is a tremendous amount of activity on practically all the railway systems in India, and hardly a day passes without an announcement of either new construction or improvement of existing lines. This is particularly noticeable in Northern India, where the North-Western Railway has in hand a big programme which has already been partially completed. For some time past the single-track section between Lahore and Rawalpindi, a distance of 180 miles, has been inadequate for the needs of ordinary civil traffic plus the heavy military movements to and from the frontier. When funds permit the whole of this section will be doubled, but until that happy day arrives it is hoped to carry on by the expedient of providing additional station crossings and improving the accommodation at existing crossings. Other schemes which will be taken in hand in the near future, some of them during the current year, include a new bridge to replace the famous old structure across the Indus at Attock, and a new bridge at or near Kalabagh; a new passenger station at Lahore; large locomotive workshops at Karachi; and important additions to the carriage and wagon shops at Lahore. It is also proposed to electrify the Kalka-Simla railway. Important extensions are proposed on the South Indian Railway, notably at Trichinopoly, where large new workshops and a colony for the staff will be erected immediately. Good progress is being made with the construction of the light railway between Dehra Dun and Mussoorie. The section of this line between Dehra Dun and Rajpur will be opened to traffic in April, but the hill section presents many difficulties, and is hardly likely to be ready for another three years. Finally, in the Nizam of Hyderabad's Dominions, the construction of the Karepalli-Kothagudium line is to be taken in hand within the next few months.

A Magnificent Avenue.

The development of Bombay has been referred to so frequently of late that possibly many of my readers will say, "Give Bombay a rest." But of the scores of columns that have appeared in English papers I do not remember having seen reference to the great Eastern Avenue, which is being blazed almost from one end of the city to the other. Seven and a-quarter miles in length and varying from 100ft. in width at its southern end to 158ft. at the north end of the island, it will form a much-needed outlet for the congested area in the Fort. Its closest analogy in London is the Bayswater-road, if I may apply that term to the variously named thoroughfare which extends from Holborn-circus to Shepherd's Bush, but the form of construction is somewhat novel in that there will be a pathway, 20ft. in width, running down the centre of the road. The latter arrangement is apparently a sly dig at the native propensity for walking in the road—a fact which accounts for a large proportion of the accidents for which Bombay has acquired a rather bad name.

Agricultural Tramways.

A big scheme of agricultural tramways is proposed in connection with the Sutlej Valley irrigation scheme. The Punjab Communications Board rightly realises that it is useless to develop huge tracts of land in the back of beyond unless transport facilities are provided for the colonists, and consequently several schemes have been prepared. They include a large number of metalled and unmetalled roads, but the most interesting suggestions concern a network of agricultural tramways laid to 2ft. 6in. gauge with 24 lb. rails. There will eventually be many hundreds of miles of these tramways, but in the first instance it is proposed to lay down a 201-miles system in the Lyallpur district. The whole question has been laid before the Punjab Government with a view to determining whether the tramways shall be run by private enterprise or by Government. In any event there is sure to be a big demand for rolling stock and materials, a fact which may well be noted by British manufacturers.

An Amazing Accident.

A typical instance of the difficulties which confront railway engineers in countries subject to torrential rains occurred a few days ago in Ceylon. The driver of a mail train was approaching a small steel bridge when he thought he saw water in front. In the darkness of the night he could not be certain, but as a matter of precaution he slackened speed, and this, as was eventually proved, saved what might have been an appalling accident. The bridge was intact, but the suddenly rising flood had washed away the river embankment beneath the permanent way on the farther side of the bridge. Immediately the engine and tender crossed the bridge the permanent way rapidly began to subside. The driver applied the brakes, but before the train could be stopped the postal and forward guard's van and one third-class bogie had all passed over the bridge. These three coaches telescoped, and the engine and tender sank 10ft. or 12ft. in the mud, but remarkably enough all the occupants, including three clerks who were in the postal van, managed to scramble safely back to the bridge. Even then the situation was dangerous, for the water continued to rise, and when assistance arrived, several hours later, the train and its passengers were marooned in the centre of a sea of water half a mile wide.

News in Brief.

Tenders are invited for water supply and drainage projects at Myingyan estimated to cost £26,000 and £6666 respectively.

An up-to-date fire brigade station is to be erected to serve the Fort (commercial) area of Bombay.

A survey has been sanctioned for a broad-gauge railway, 28 miles in length, from Tulsar to Tirodi, on the Bengal-Nagpur Railway.

The Government of Afghanistan is advertising in the Indian papers for canal engineers, but no further details are available.

Letters to the Editor.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

SCIENTIFIC LITERATURE.

SIR,—A quickened interest in education generally has been made manifest in this country since the Armistice, and, perhaps, the necessity for an improved system of scientific education has received the major share of attention. It is clear, therefore, that scientific literature occupies a very important position, and the following letter deals with certain aspects of this subject.

During the last twenty years the writer has made a practice of examining most, if not all, treatises published in English on mathematics, physics and kindred subjects, and also a considerable number of French and German works on the same branches of science, and has given much attention to the form and style of exposition, letterpress, illustrations and diagrams appearing in the books.

Among the many new treatises published every year on each of these sciences, there are not a few which seem to contribute little or nothing to the literature of the subject; they contain practically no new matter, and are often inferior in exposition and general treatment when compared with earlier works.

From the point of view of those for whom the books are written, whether student, teacher, or practitioner, it would be a great benefit if some independent body of recognised standing in the scientific world would indicate a suitable form of treatment, letterpress, style, and kind of illustrations and diagrams for treatises on each branch of science, to which it is desirable that writers and publishers should conform. Of course, new and important treatises on scientific subjects and new editions of existing books are generally reviewed in scientific journals and occasionally in other sections of the Press; but criticism, especially where it takes the form of disagreement with the work, is mainly of a negative character, and often concerned only in pointing out errors and other details. Clearly, criticism of this kind is necessary, but it rarely goes on to indicate the form and treatment desirable for the subject in the work under review.

What has been the practice to date, in so far as the genesis of new scientific books is concerned? The manager of a publishing company concludes that there is need for a new work, or a new edition of an existing one, on some section of science.

How does he form this opinion? Perhaps he has received many inquiries for a treatise on the subject in question, or it has been suggested to him that there is room for a new work on this branch of knowledge. And if he decide to proceed with the project he looks about for an authority to write the book.

Again, a specialist approaches a publisher with a completed manuscript on his particular subject, or, alternatively, suggests that he should write a book on his subject.

Now, whichever of these may occur, and whether the financial risks are carried in whole or in part by the publishers, or even if, as happens occasionally, they are borne entirely by the author, the decision to proceed rests finally with the directors and manager of the publishing company, although expert opinion may be called in from an independent source to assist the management.

And this decision, if it be favourable, entails a further decision as to the form of treatment, letterpress, style, and kind of illustrations and diagrams in the work.

But on other occasions as they arise this same manager may be called upon to sift the evidence in favour of producing a work on some one of the many branches of mathematics, electricity geology, botany, a treatise on a branch of medicine or a section of English or foreign literature, &c. &c.

His task may bring him into contact with any subject in the whole range of knowledge and learning, and in every case it is expected of him that he shall be competent to determine the most suitable form and style in which to produce the book.

Does this make for efficiency in any one of these very large subjects?

A Committee, or Committees, of, say, the British Association for the Advancement of Science could do very much to suggest, as far as scientific literature is concerned, the kind of treatises most suitable in the interests of the student, teacher and practitioner: the suggestions dealing with treatment, exposition, form, letterpress, style and kind of illustrations and diagrams in the books.

By this means the B.A.A.S. would exert additional influence in the direction and advancement of scientific education in its broadest sense, by way of suggestion and advice only, and without, of course, attempting to restrict in any way the liberty of action of authors and publishers.

But, on the contrary, it would confer on these authors and publishers the benefit of advice from a body such as the B.A.A.S. which is at the very centre of the scientific world, and whose opinions, based on intimate knowledge of the subject, must thus carry great weight. The publisher also needs to have, or to obtain, accurate information in regard to the requirements of the users of the treatises he is about to publish, and a central body, such as the B.A.A.S. can collect information of this kind from all sources with great thoroughness. If the suggestions made in this letter were carried out, it would amount to taking one further step towards systematising education in the world of science.

After a survey of the field had been completed, the work of the B.A.A.S. would not be heavy, for there would be no difficulty in keeping abreast of the requirements of scientific literature in this respect. Scientific literature is surely the most important channel through which scientific knowledge is disseminated. Why, then, should it not receive the encouragement and assistance, by way of suggestion, which an Association existing for the advancement of science can give, an Association numbering on its membership roll most of the leading scientists, professors and teachers of science throughout the Empire? Moreover, the B.A.A.S. is without any vested interests in publishing matters and is entirely independent therefrom.

But in this connection it may be remarked that a few professors and teachers already write treatises and recommend these to their classes as most suitable for the curriculum.

But these professors and teachers could be invited to collaborate with the B.A.A.S. Committee suggested above, and in view of the fact that a very large number are already members of the B.A.A.S., the latter body is placed in a uniquely suitable position to undertake the work.

If the above suggestions were carried out, the work of the B.A.A.S. would appear in the form of comprehensive and general suggestions dealing with the several points connected with the production of the scientific treatise, to which all authors and publishers would have access on an equal footing.

February 10th. T. W. MACALPINE.

A WARNING TO INVENTORS.

SIR,—I enclose a copy of a letter which is being circulated among British inventors and patentees. As several members of this Institute have received this letter, and their inventions belong to widely different fields, it seems strange that one man should have anticipated them all. In each case he admits that the British inventor is first in the field, in spite of which he asks permission to take part in the British invention, and, in addition, to receive a sum of money; but what for? As in the cases under my notice the time for applying for the foreign patent is past, the last paragraph of the letter is quite inaccurate. The entire letter appears to be an attempt to induce the inventor to part with money, for which he is not likely to receive any material benefit.

G. DRURY COLEMAN,
Organising Secretary, Institute of Patentees.

O. Stolz
Westdeutsches Ingenieurbüro
BONN a. Rhein

Bonn a/Rhein
3th Februar, 1923.

DEAR SIR,

We are sorry to infarm you that we have the same invention and an account of your farmerly ancounced British patent a new patent license will be refused in Germany. In the course of the trial to apply the patent in England we found now your equal invention and we can only cover the costs if you allow us to take parts in your intervention. We would not like to work with the help of a patent office because selling would only be delaget and it would be too dear for us, because our Mark is so much down.

On account of the sinking of our Mark we would also be ready to accept a minor part in your invention but then you had to send us for the costs a small paying in advance for instance £½ to 30% part, £1 to 20% part, £2 to 10% part. You are kindly asked to send us this sum in a registered letter that we may exacute this affair in all countries.

We have necessary writtings and samples of the invention and you may hear of the negociation by written, that the highest prices for selling may be obtained. Nothing would be in the way of the further apply for patent in America, Sweden, Norway, Denemark, the Netherlands, France and Germany, and with which we began alredy and which costs are ours.

Yours sincerely,
O. STOLZ
Westdeutsches Ingenieurbüro
BONN a. Rhein

(Sent in an open letter to be dispached quicker.)

"BALTIC" TYPE LOCOMOTIVES.

SIR,—As the originator of the term "Baltic" for express locomotives having a fire-box of such length that a four-wheeled bogie is required for its support, may I point out that, for many years previous to the need of such terminology, suburban tank locomotives in large numbers were employed in France with this same arrangement of a trailing bogie; but, as it never presented any remarkable constructive feature, or the solution of some locomotive problem, there was no occasion to signalize the arrangement by a special name. The designation "Baltic" implied an express engine with a separate tender having a four-wheeled truck to carry a long and heavy fire-box, and not merely a convenience for running tank engines forwards or backwards without turning them at the terminals. "Baltic" implies an engine of from 2000 to 4000 horse-power.

CHARLES R. KING.

February 10th.

UNIVERSITY OF LONDON.—A course of four lectures on "The Control of the Speed and Power Factor of Induction Motors" will be given by Professor Miles Walker, M.A., D.Sc., Professor of Electrical Engineering in the University of Manchester, at the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2, at 5.15 p.m. Syllabus:—Lecture I., February 21st: Characteristics of the induction motor. Lecture II., February 26th: Various methods of changing the speed of induction motors and their use in motor applications. Lecture III., March 14th: The use of double and triple circuits in series with the rotor; applications to ship propulsion; method of foretelling the characteristics. Lecture IV., March 21st: Phase advancers and alternating-current exciters; speed changing by alternating-current excitation; other methods of injecting alternating-current voltage and their practical applications. Admission will be free, without ticket.

A Seven-Day Journal.

Overtime and Night Work in Shipyards.

LAST Friday night, after two full days of negotiation, representatives of the Shipbuilding Employers' Federation and of the Federation of Engineering and Shipbuilding Unions, meeting in London, certain proposals were formulated for dealing with the highly complicated question of the regulation of, and payment for, overtime and night shift work in shipyards. The negotiations were adjourned in order that both sides might lay the proposals before their respective organisations for consideration. So far as the men are concerned, it is understood that such consideration was to be given to the matter yesterday —Thursday—at the Federation's conference at York. The terms proposed have not at the moment of writing been disclosed, an agreement to keep them secret for the meanwhile having, it is understood, been made between the two sides. It is gathered that overtime is not to be made systematic, and is to be resorted to only for special work and mainly for repairs. The question has become a pressing one in view of the fact that in the absence of general agreement regulating overtime and night work delay has occurred in effecting repairs to ships, with the result that, as has been repeatedly reported, owners have had to send their vessels abroad for overhauling. The hope has been officially expressed that a settlement will soon be reached with all the unions concerned in the matter, but it is clear that with the numerous rates, &c., in force the solution reached will not be a simple one.

New Coke Oven Plant.

IN view of the present scarcity and high price of coke, special interest attaches to the fact that at Pelton, Durham, the Stella Gill Coke and By-Products Company has constructed, and is about to bring into use a new battery of fifty coke ovens which will be capable of dealing with 12,000 tons of coal per month. The ovens are of the regenerative, vertical flue type on the Simon-Carves principle, and are to be worked in conjunction with a very complete system of by-product recovery plant. It is anticipated that the output per month will be about 7000 tons of coke, 400 tons of crude tar, 120 tons of sulphate of ammonia, and 20,000 gallons of crude benzol. A scheme for the distillation of the tar is under consideration, so that ultimately the plant may be capable of adding creosote, naphthalene, anthracene and pitch to the list of its products. Provision has been made for extending the whole installation at a later date to double its original capacity.

The Bessemer Gold Medal.

THE Council of the Iron and Steel Institute has awarded the Bessemer Gold Medal for this year to Dr. W. H. Maw, LL.D., joint editor of our contemporary *Engineering*. Dr. Maw is now eighty-five years old, and has been a member of the Iron and Steel Institute for the past forty-nine years. He is the present President of the Institution of Civil Engineers, and is a past-president of the Institution of Mechanical Engineers and of the Royal Astronomical Society.

Imported Motor Cars.

THE low duty on imported motor cars, commercial vehicles and parts has resulted, according to the Midland Council of the National Union of Manufacturers, in placing the industry in this country at the mercy of the Americans. At a meeting of the Council on Tuesday, in Birmingham, it was decided to ask the administrative committee of the Union to call a conference of British motor manufacturers with a view to discussing a request to the Government to raise the duty to an effective level. It was anticipated that with foreign competition kept within bounds, it would be possible for the home manufacturers to increase their outputs, reduce the price, and employ more labour.

Motor Tramp Ships.

A CONTEMPORARY has raised the question whether the motor ship is making much progress in the favour of owners of tramp vessels. It has come to the conclusion that there are comparatively few orders for motor cargo ships being given out, and that in those cases in which internal combustion engines are specified the vessels are not of the tramp class. The tramp vessel does a rough-and-tumble carrying trade, and must essentially be economical, both as regards first cost and running expenses. On this score owners of such ships appear to prefer triple-expansion steam engines, and to regard the Diesel engine as not yet having established an equal position in the matter of economy, trustworthiness, and general suitability for their purpose. At a recent meeting of the Court Line in London, the chairman openly declared that his company was adhering to steam engines for the present, and would leave Diesel engines alone for some time to come, until others had carried out the necessary experiments. Another shipowner, speaking a short time ago at Newcastle, put the matter more precisely. An 8000-ton steam vessel, he said, would cost at present about £70,000, whereas a motor ship of the same deadweight capacity would cost about £100,000. For a steamer they could allow, he added, a depreciation of 5 per cent. per annum, and could calculate its effective life at twenty-five years. For a motor ship, however, these factors were very largely unknown. It may be worth while recalling in connection with this important subject, that according to Lloyd's Returns for the fourth quarter of last year the number of motor vessels under construction in this country was twenty-six, as compared with 277 steamers, and that for the rest of the world the number amounted to eighty-one as compared with 348 steamers. It seems evident, therefore, that British shipowners are shier of the Diesel engines than their foreign colleagues, for whereas in this country there was one motor ship for every ten steamers under construction, abroad there was almost one for every four.

Automatic Telephones.

THERE are now sixteen public automatic telephone exchanges in existence in this country, with an aggregate ultimate capacity of 50,000 lines. Development in this direction is proceeding rapidly, and within the next few years, according to the Postmaster-General, will result in something like a revolution in telephony. Some of the existing stations are being extended, and new exchanges are being installed at Dundee, Southampton, Swansea and elsewhere. In addition, orders are about to be placed for automatic equipment for Brighton, Gloucester, Halifax, Kirkcaldy, Sheffield, York, and elsewhere, and preliminary arrangements for buildings, &c., are being made for installations at Bath, Bedford, Coventry, Edinburgh, Exeter, Ipswich, Leicester, Newcastle-on-Tyne, Newport, Nottingham, Middlesbrough, Plymouth, Preston, and one or two other towns. The introduction of automatic plant in the big cities, especially in London, is a matter of great complexity, and requires the exercise of much caution from the financial point of view.

The First British Trade Ship.

THE steamer British Trade is now at Hull, at the shipbuilding and ship-repairing establishment of Livingstone and Cooper, with a view to fitting her out for her forthcoming world tour of 41,000 miles as a trade ship. It is understood that she will leave the Hull yard ready in every respect for her voyage, except that she will return to London to take on board certain exhibits. Her sailing date has been fixed for June 2nd. The cruise will last for ten months, and will include visits in rotation to South America, South Africa, Australia, New Zealand, Japan, China, the East Indies, Burma, India, the Suez Canal, and the Mediterranean.

The Boothferry Bridge.

SINCE we started at the beginning of this year to summarise week by week the contents of the issue of THE ENGINEER for sixty years ago, we have been greatly struck by coincidences between the subjects then dealt with and those in our minds to-day. One of the most curious is to be found in to-day's paragraph, in which we give brief particulars of the life of a very versatile yet thoroughly typical engineer of the old school, Mr. Joseph Glynn. One of his many and varied works was the construction of a lifting bridge across the river Ouse at Selby, in Yorkshire, for the Hull and Selby Railway. At the present moment the cross-river bridge at Selby is engaging much local attention, for a scheme is afoot to replace it by means of a great new bridge at Boothferry, fifteen miles distant, in order to facilitate communication by road between Hull and South Yorkshire. The existing Selby bridge is a toll bridge, and is limited to loads of 5 tons. The proposed new bridge would cost about £100,000, and would have a 100ft. opening span. The Ministry of Transport is interested in the matter, and might be prepared to contribute 50 per cent. of the cost, while several of the local authorities are keenly desirous of seeing work upon the bridge begun at a very early date.

Making Rain by Aeroplane.

IT has before now been proposed to cause the precipitation of rain by means of aeroplanes, although so far as we can recall we have previously neither heard of the idea being put into practice, nor how precisely it was intended to carry it out. A message received from Dayton, Ohio, indicates that the problem has now been attacked and successfully solved by the United States Army Air Service. According to the report referred to, Professor Bancroft, of Cornell University, has been conducting experiments during the past few months on the dissipation of fogs over aerodromes, and has attained success in so far as he can now cause precipitation of rain clouds by flying an aeroplane 500ft. or so above a cloud, and causing it to scatter with its propeller electrically charged sand. The theory is that the electrical charge on the sand diminishes the surface tension of the drops of moisture and thus facilitates coalescence and condensation. There is, of course, nothing in the least improbable in this report. Indeed, it is quite in keeping with previous researches in this and other countries on the dissipation of fog and similar subjects, such as those carried out by Sir Oliver Lodge, and with the results obtained with the electrostatic process of cleaning blast furnace gases from dust.

Night Flying Experiments.

THE first attempt to fly from Croydon to Paris during the hours of darkness by means of the beacons and other illuminated signs provided on the route by the respective authorities was made on Monday of last week, but unfavourable misty weather led to the attempt being abandoned after Lympne had been reached. On the evening of last Friday, however, success was attained. A DH 9 machine, piloted by Mr. Broad and carrying Captain Biddlecombe, the Air Ministry's lighting expert, as passenger, left Croydon Air Station at 8 p.m., passed over Folkestone at 8.48, and arrived safely at Le Bourget, the Paris Air Station, at 10.53 p.m. The return journey was accomplished on Sunday night, the machine leaving Le Bourget at 7.20 p.m., passing across the French coast at 9 p.m., and reaching Croydon at 10.30. The success of these experiments will, in the opinion of many, lead to a considerable development in the cross-Channel air services.

Crude Oil Aero Engines.

ACCORDING to a London daily newspaper, the Air Ministry has made arrangements with William Beardmore and Co., Limited, for the construction of a crude oil aero-engine to develop 1600 horse-power. As long ago as September 22nd we published some information on this subject in the Journal, and no later than last week at the Air Conference the Director of Research at the Air Ministry stated that Messrs. Beardmore were making initial tests with a single cylinder on direct fuel injection, with a view to the ultimate adoption of the system in a six-cylinder vertical aero-engine. Either, then, our contemporary has resuscitated an old story or the position is very much farther advanced than one would conclude from Sir Geoffrey Salmond's words.

Sixty Years Ago.

QUITE the most interesting item to the modern reader in our issue of February 13th, 1863, is the obituary memoir which we published on the occasion of the death of Mr. Joseph Glynn, for many years chief engineer to the Butterley Iron Company. The account given of Mr. Glynn's life illustrates the tremendous change which has occurred in the profession of engineering since his day, for in those times an engineer worthy of the name was no specialist, but could pass, as did Mr. Glynn, from the designing of gasworks and the drainage of fen lands to the construction of marine engines, the laying out of railways, the building of locomotives, bridges, and cranes, the application of hydraulic power, and the planning of canals. Mr. Glynn, it is recorded, was born in 1799, and was a school fellow of Robert Stephenson. His father was the proprietor of the Ouseburn Iron Foundry, Newcastle-on-Tyne. His first engineering work consisted of the erection in 1820 of a steam engine for a Cumberland colliery, in the execution of which he was assisted by two young mechanics. These workmen lived to attain great eminence, as "the late Sir Peter Fairbairn and Mr. Robert Hawthorn." He designed gasworks for Berwick-on-Tweed and Aberdeen, played a large part in equipping the vessels of the General Steam Navigation Company with engines and boilers, drained many thousands of acres of marsh land in the counties of Cambridge, Norfolk, Suffolk, Lincoln and York by means of steam-driven scoop wheels, constructed the lifting bridge at Selby on the Hull and Selby Railway, was concerned with the setting out of the Midland Counties Railway, and acted as chairman of the Eastern Counties Railway. In 1847 he read a paper before the Civil Engineers entitled "A Review of the Plans which have been Prepared for Connecting the Atlantic and Pacific Oceans by a Navigable Canal," in the discussion on which the Emperor of the French, then Prince Louis Napoleon, took an active share, and in 1851 a paper "On the Isthmus of Suez and the Canals of Egypt," a paper which, we recorded, "drew forth a most interesting disquisition from Mr. Robert Stephenson."

Trials of the Fezara.

ON Thursday last, the 8th inst., we were present at the Clyde trials of the ss. Fezara, a passenger and cargo vessel of 10,250 tons displacement, built by Alexander Stephen and Sons, Limited, Linthouse, Glasgow, for the Khedivial Mail Steamship and Graving Dock Company, Limited, London. The occasion was one of enhanced interest on account of a demonstration of the working of the Clyde oil fuel burning system with which the boiler installation is fitted. Like her sister ship, the Famaka, which was also built by Stephens and similarly fitted, the Fezara is specially designed and equipped to meet the requirements of the company's Alexandria to Constantinople service, and these two latest additions to its fleet are noteworthy with regard to size and speed and the comfort of the passenger accommodation.

SOME MACHINERY PARTICULARS.

The general appearance of the vessel may be gathered from the view of her taken during the trial which we reproduce in Fig. 1. Her leading dimensions are:—Overall length, 405ft.; length between perpendiculars, 390ft.; overall breadth, 55ft.; depth, 30ft. 6in. The main propelling machinery consists of one set of Brown-Curtis type turbines in conjunction with single reduction gearing. The high-pressure and low-pressure turbines are connected by means of flexible couplings and pinions to the main gear wheel. This wheel is mounted on a short shaft which drives the thrust shaft, on which there is a block of the Michell type. The astern turbines are incorporated in the main turbine casings and are designed to develop 70 per cent. of the full ahead power, which under sea conditions at 12.5 knots corresponds to 3150 collective shaft horse-power at a propeller speed of 110 revolutions per minute. The speed of the high-pressure turbine is 2000 revolutions per minute and that of the low-pressure turbine 1800. The condenser has a surface of 3580 square feet and is of the underhung Uniflux two-flow type, designed for a vacuum of 28½in. with circulating water at 60 deg. Fah. A Weir dual type air pump with a 12in. steam cylinder and two 24in. diameter air pump cylinders having a stroke of 15in. is used, while the circulating pumps are of the Drysdale type and are steam driven. The electric lighting installation comprises two sets of dynamos driven by Shanks engines, and we noted the usual equipment of feed, fuel and lubricating, ballast and bilge pumps, by Weirs, Nichols, Thom and Lamont and Drysdales. A somewhat novel type of emergency bilge pump by Drysdale and Co., Limited, may be specially mentioned. This 100 tons per hour pump is of the vertical motor-driven type with the motor running at 1200 revolutions per minute in a water-tight air bell, so that the pump will still continue to work when fully submerged. A twin set of air freeing pumps, worm driven from the main shaft, forms an integral part of this pump. A complete system of "Teledep" tank depth indicators, by Dobbie, McInnes and Clyde, is fitted to all fuel compartments and the main ready-use storage tanks.

THE BOILER INSTALLATION.

The boiler installation comprises four single-ended boilers of 14ft. 9in. mean diameter by 11ft. 6in. mean length, designed for a working pressure of 215 lb. per square inch with 200 deg. Fah. superheat, the North-Eastern type of superheater being installed. Fig. 2 illustrates one of the boilers, from which it will be seen that three furnaces of the Howden forced draught type arranged for either coal or oil firing are provided on each boiler. The furnaces proper are of the Morrison patented corrugated pattern, and for oil burning the whole of the fire-bars are removed, a procedure which by general consent admits of the maximum efficiency being obtained. A complete set—one for each boiler—of CO_2 combustion indicators, by the W.R. Patents Company, Limited, is installed, and during the trial they were shown in continuous operation. The results as calibrated by a standard Orsat apparatus indicated a high degree of accuracy.

THE CLYDE OIL FUEL SYSTEM.

As we have already mentioned, the prominent feature of interest in this trial was the demonstration of the working of the Clyde low-pressure jet system of oil fuel burning and the specially designed pumping and heating units, burners and starting apparatus, all of which are manufactured by Alex. Stephen and Sons, Limited, that company being the sole licencee of the Clyde Oil Fuel System, Limited, of London and Glasgow. Each pumping unit, two of which are installed in the engine-room, consists of a standard Weir type fuel oil pump with a duplex straining device and a new design of oil heater. Unlike the coil type of heater, in the Clyde heater the oil flows in series through the tubes, and a number of tubes is provided, so that the failure of any one does not impair the working of the heater. The design is such that the oil space may be easily examined and cleaned, and allowance is made for the unrestricted expansion of the heater tubes without introducing any bolted joint between the steam and oil spaces. Heaters of the Clyde design have been able to deal successfully with heavy residues from oil stills, and have remained in continuous operation over long periods without attention and regular cleaning.

The general arrangement of the burner holders and the oil fuel connections on the furnace doors is illustrated in the view reproduced in Fig. 2. The oil main from the heater passes along the boiler front, and a tapping for each furnace is taken off through a distance piece furnished with a thermometer connection and coupled by means of a short pipe to the burner arm clamping and fuel control device, which is fixed immediately above the furnace door below the upper air control. Each burner is carried on an L-shaped arm, at the lower extremity of which the spraying nozzles are placed. The nozzle is of a neat design with four oblique holes converging on to a finely pointed steel cone immediately before the spray orifice. The cone is so arranged that it is protected by a rim from any damage which it might sustain by falling. Inspection holes are provided on the door for observation and for the reception of the lighting-up torch. At the extreme left-hand side of the furnace there is a sight glass which permits the examination of that part of the flame which impinges on the corrugated furnace tube. As in the case of the Clyde natural draught system, no brickwork or brick linings of any kind are employed in the furnace. The whole of the air for combustion is given a definite circulation over the pressed steel furnace front closing plates and may be controlled in such a manner that the combustion is carried on well forward, protecting the back ends from local heat and augmenting the heat of the air used for combustion. By this means a high efficiency is obtained, and the absence of brickwork reduces initial and maintenance costs and enables ready access to the furnaces without removal of the air directors.

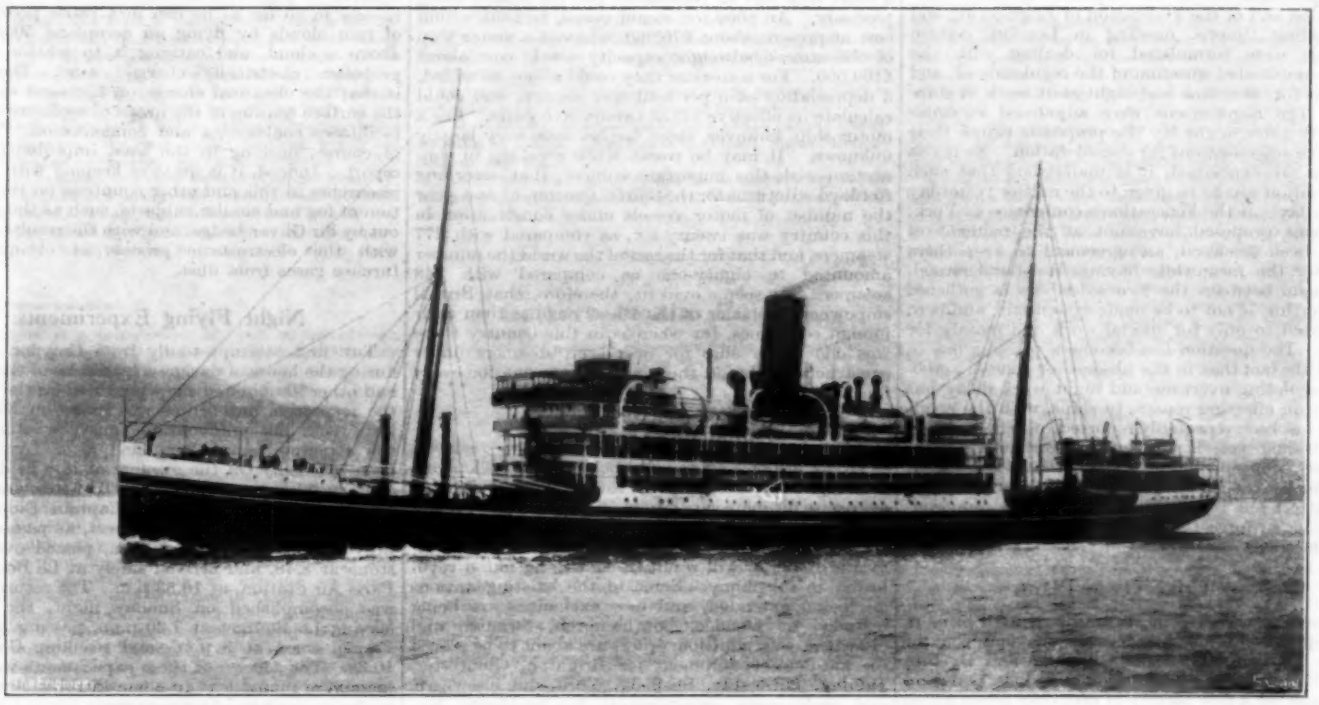


FIG. 1—KHEDIVIAL LINE STEAMER FEZARA ON TRIAL TRIP

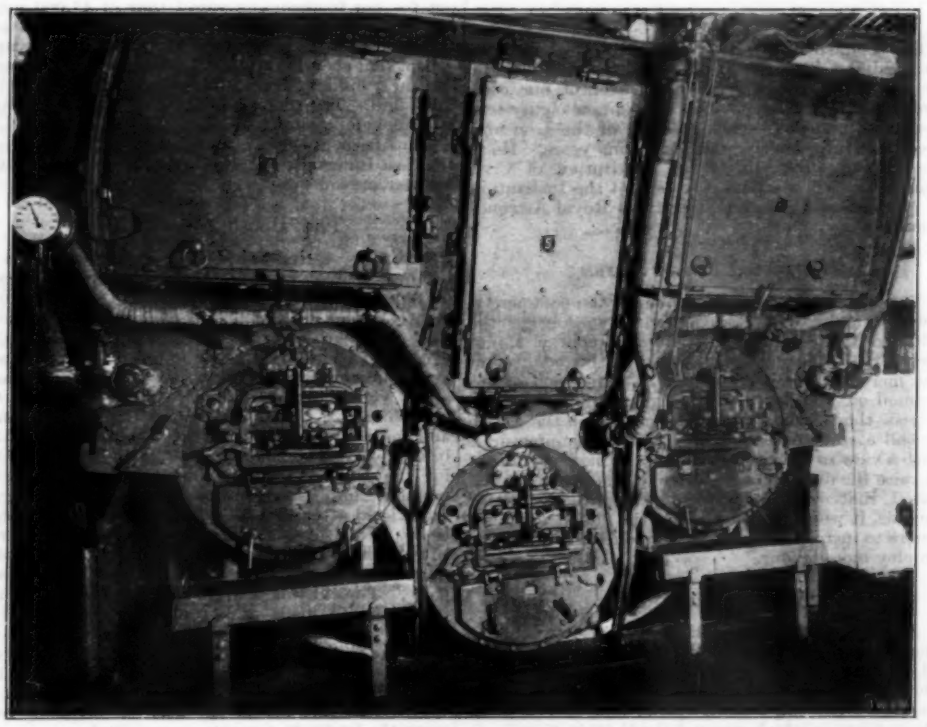


FIG. 2—BOILER FITTED FOR OIL FIRING

The burner may be removed from its holder in less than half a minute and then the door may be opened. But when the burner is in operation the door cannot be opened. This arrangement provides a safety device against accidents. A special point with regard to the installation is the very short time in which a complete change over from oil to coal firing or from coal to oil firing can be made. On the Famaka the change was made in less than three hours.

Extract from Log of Trial Run on Measured Mile at Skelmorlie, February 8th, 1923.

Total oil fuel consumption for 4½ hours' run, 5.9 tons.

Time.	Boilers. Number in use.	Boilers. Mean pressure.	Boilers. Mean superheat.	Oil pressure at heater.	Oil pressure at boiler.	Nozzles. Size.	Nozzles. Number in use.	Temperature of oil. Settling tank.	Temperature of oil. Entering furnace.	Temperature of gases at base of funnel.	Revolutions of fan engine.	Air pressure. Fan.	Air pressure. Furnace. Top.	Air pressure. Furnace. Bottom.	Double strokes of feed pump.	Propeller revolutions.	Shaft horse-power.
			Deg. Fah.					Deg. F.	Deg. Fah.			In.	In.	In.			
11.30	4	217.5	156	103	100	16	12	72	140	412	245	2½	½	½	3½	109.25	2880
12.32	4	208.7	164	93	90	16	12	72	150	420	245	2½	½	½	3½	110.9	3225
1.50	4	215.2	151.5	90	85	16	12	73	150	417.5	245	2½	½	½	3½	111.5	3195
2.50	3	204	190.9	120	105	16	9	75	155	450	250	2½	½	½	3½	108.7	2950
3.20	3	212.3	192.7	123	115	16	9	75	150	450	260	2½	½	½	3½	112.2	3170
Mean*		211.9	170.3	105.1	97			72.9	151.5	431.5	248.5	2.32	.41	.54	3.55	111.26	3137

Consumption for all purposes at 3137 S.H.P. = .972 lb. oil per S.H.P. per hour, equivalent to .875 lb. oil per I.H.P. per hour. *All records.

A very simple starting-up device is provided. It takes the form of a small vertical boiler about 2ft. 6in. in diameter by 4ft. high, which is heated by a Clyde vapour burner started by a burner of the Primus type and fed by a hand-operated fuel pump. Steam is raised to a pressure of 100 lb. per square inch in a period of twenty minutes, and the boiler then generates sufficient steam to work one of the pumping and heating units.

SOME TRIAL RESULTS.

During a trial of four hours a mean speed of 12.75 knots, corresponding to 3137 shaft horse-power, was maintained. The total amount of oil consumed in a period of 4½ hours was 5.9 tons, or 0.972 lb. of oil per shaft horse-power hour. The oil used for the trial was fuel oil refined in Scotland at Uphall refinery from Persian crude oil imported through Grangemouth. It had a specific gravity of 0.89–0.90, and was heated and delivered to the boilers at 75 lb. per square inch and at a temperature of 145 deg. Fah. A mean reading of the CO_2 indicator was about 13 per cent.

The operation of the machinery was characterised by smoothness and quietness of running throughout the trial, and the vessel, which was fully loaded, left for Alexandria the same evening. In a later article we hope to give some further particulars of the Clyde oil fuel system and to describe the different forms of heaters and burners used on land and marine installations.

A Blue Print Washing Machine.

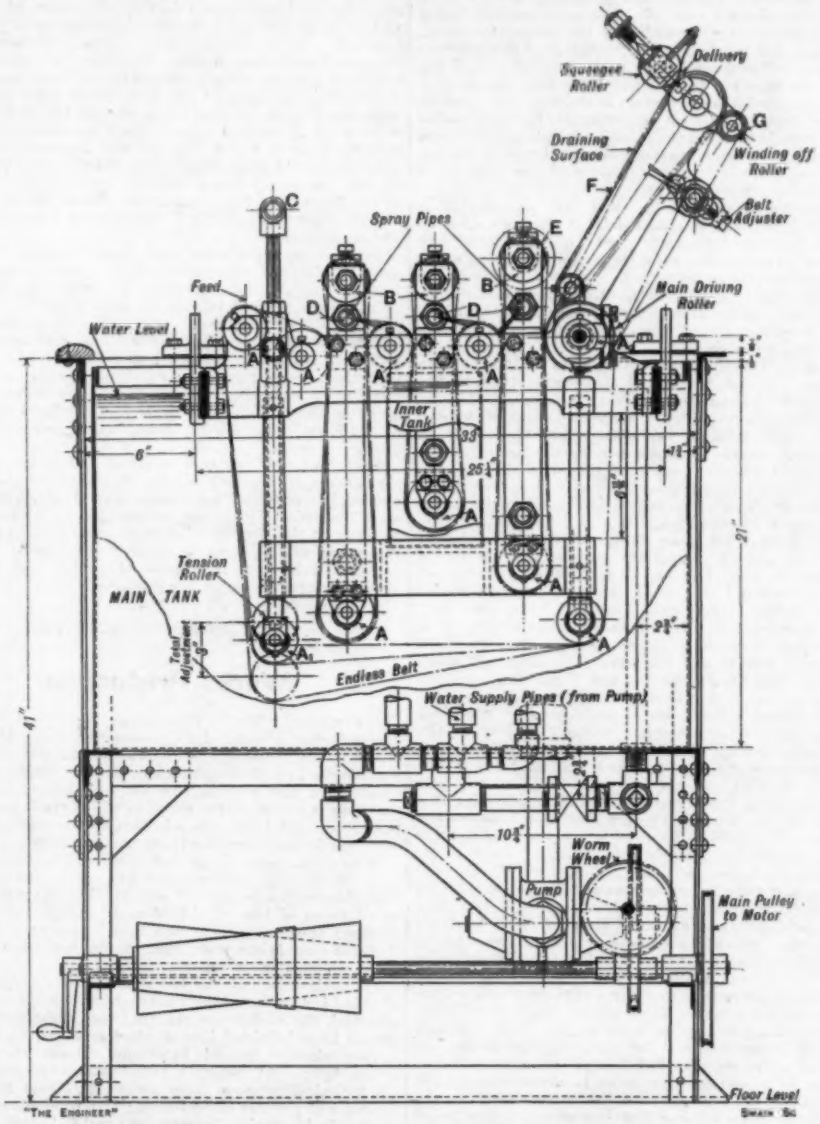
ALTHOUGH there is in common use a large variety of machines for printing tracings on to blue and other papers, and also machines for drying the prints after they have been developed, we believe that no satisfactory scheme has up to now been evolved for mechanically washing the prints. The machine which we illustrate by the accompanying drawing does, however, so far as we can see, meet all the requirements and should soon supersede the old-fashioned washing tank in drawing-offices where any considerable number of prints has to be produced.

The machine, which is manufactured by Precision Photo Printing Plant, Limited, of 120, Moorgate, London, E.C. 2, is the outcome of a considerable amount of experimenting, but retains the same broad principle which was adopted at the start. That is to say, the prints are continuously passed through a deep tank of water, gripped between a woven wire belt and a set of fabric tapes. The tapes bear against the exposed face of the print, while the wire belt is behind. The success of the machine is dependent very largely upon this belt, as it is naturally important that the prints should go squarely through the machine and that they should not be torn or damaged in the process. The belt is made of a non-corroding bronze wire and has a peculiar mesh some 3in. wide, across the belt, by about ¼in. along the length. The wires are so bent that one face of the belt is quite flat and all the kinks at the crossings appear on the opposite side. Grooves are cut in the various rollers over which the belt passes, to accommodate the kinks. The individual wires reach from side to side of the belt, and it is a comparatively simple matter, in the unlikely event of a wire breaking, to thread a new one in its place.

This wire belt, which is shown plainly in the end view of the washing machine, passes over all the rollers marked A. The lower front roller A_1 is adjustable vertically for taking up any slack, while another small roller at the back of the machine is used to keep a definite tension on the belt. This roller is obscured by the framing and is carried by bearings in links which rock round the shaft of the roller A_2. The weight of the roller makes it bear against the belt just below A_2 and thus puts the requisite tension on the belt.

The tapes, already referred to, between which and the wire belt the prints are gripped, take the form of three sets of endless bands. They run over the three rollers B B B and are kept in their proper positions by small rubber bands. These bands are put on the rollers under the tapes and act in the same manner as the crowning of a belt pulley in preventing the tapes from creeping along the rollers. We may say here that no trace of the tapes is seen in the prints.

The prints are fed into the machine on the top of the wire belt as it passes over the front roller A and immediately come under a row of high-pressure water jets issuing from the pipe C. This pipe is connected with the town's mains and the jets provide the whole of the fresh water necessary for washing the prints. After passing the spray the prints are gripped between the first set of tapes and the wire belt and are carried down into the tank. On coming up again on the opposite side of the loop the paper is deflected towards the next pass by the water jets D and is, of course, incidentally given a further washing. The water for these jets is drawn from the bottom of the tank and supplied to the spray pipes by a rotary pump driven from the same motor that works the rollers. It will be noticed that during one of the passes the prints are carried through a separate tank arranged inside the main tank. This inner tank may be filled with a bichromate solution for counteracting the effects of over-exposure of the prints. An overflow is arranged at the back of the main tank, so that there is a constant flow of water through the machine.



BLUE PRINT WASHING MACHINE

On leaving the last pass through the tank the prints would have a natural tendency to stick to the tapes and be pulled over the top of the back roller. This roll is consequently furnished with a number of sharp-edged rubber flanges E arranged between the tapes, which throw the print off on to the endless rubber band F. Most of the water is drained off from the paper as it travels up this band and the remainder is squeezed out by a polished metal roller at the top. The prints are directed off the squeegee roller by light metal fingers and drop back on to the roller G. This last roll is driven at a slightly higher peripheral speed than any of the others and thus ensures pivot bearings which can be adjusted for height, while the others have plain half bearings that can conveniently be lubricated with grease. In the front of the main tank there is a narrow open well in which prints can be given a preliminary dip before being machine washed.

The width of the belt is 45in., so that prints 42in. wide are easily accommodated, and it can be run at any speed between 3ft. and 12ft. per minute. The maximum capacity is thus some 300 double elephant sheets per hour.

A PAPER on the cost of idle days in mining, read by the late P. S. Peabody before the International Railway Fuel Association of Chicago, gives the total annual loss in the American bituminous coal mines as over 400,000,000 dols. This figure is arrived at on the assumption that the mines could produce 1,000,000,000 tons a year, that 700,000 men are employed by the mines, and that they work, on the average, 200 days a year.

Seaplanes.*

By C. R. FAIREY, M.B.E., F.R.Ae.S.

IT is a remarkable fact that although at quite an early stage the design of aeroplanes settled down into practically one universal type, *i.e.*, the tractor, owing to its preponderating advantages in general arrangement and performance, the seaplane is still in an unsettled state even as regards an accepted general arrangement of components. There are quite sharply-divided opinions as to the relative merits of different types due partly to the fact that proper comparative tests under varying conditions, have never been made, and much that is matter of opinion to-day could, by proper full-scale experiment, be established as matter of fact. The design of seaplanes is, therefore, a subject on which it is as difficult to dogmatise as it is easy to start a discussion.

MODERN TYPES.

Although there is as yet no settled type of seaplane, machines of this class may be divided into two main categories—the flying boat and the float seaplane. In the flying boat the superstructure, in which the engines are mounted, is built on a single central hull taking the place of the fuselage of the aeroplane, and since the centre of gravity is nearly always above the metacentre, lateral stability on the water is provided by wing-tip floats. This type has been built in sizes varying from small single-seaters to large four-engined machines weighing 32,000 lb. gross.

With flying boats the principal division of type lies in the arrangement of the step and shape of the hull beneath the water-line. Although there are very few examples of what might be called the single-step hull, the second step in most hulls is so atrophied as to represent little more than a skin wave breaker to keep the tail clean. In operation the difference lies in the fact that the single-step type at or over hydroplaning speed exerts only small trimming moments due to water pressure, which can be overcome by the air controls, the arrangement being roughly analogous to the ordinary two-wheeled type of land chassis, and the fore and aft attitude of the machine when taking off and landing is under the control of the pilot, the machine not being stable as a boat unless that control is exerted after a certain speed has been passed. It has the advantage that a large angular range of movement is available to assist the machine in riding over rough water head on to sea and prevent any tendency to burrow in a head sea, but it is very subject to "porpoising" if not skilfully controlled.

With the two-step type in which the second step is highly developed, the intention is that the hull shall be stable from zero to taking off speed, and shall itself take up the best attitude when running on the water. It needs accordingly less skill in piloting, but has not the advantage of the single-step in a rough sea. Most modern machines have adopted a compromise between these two conditions in which the second step is very small and the best features of both types are obtained.

Under the water-line both these types of hull vary in design from the flat bottom of the Savoia type to the sharp V of the Linton Hope hulls. The flat type, by its greater hydroplaning efficiency is easier to take off smooth water but meets with correspondingly greater impact on landing. The V-type makes much easier landings, but its hump speed is higher and not so sharply defined.

A new type of German boat has recently appeared, the Dornier, in which an attempt is made to avoid the use of wing-tip floats by employing lateral extensions on the hull in the form of buoyancy chambers, which are shaped in the form of thick wing sections and are intended to give some lift in the air. For smooth water this type appears promising, but could not possibly have the lateral stability of the three-float machines. Attempts have also been made in Germany in the Oberst boats to provide the boat with sufficient beam to avoid the use of wing-tip floats at all. Both France and Italy favour the flat-bottomed hull, but all English designs are now V-pattern.

The float type of seaplane is in appearance a normal aeroplane in which the floats or pontoons take the place of the usual landing chassis. Actually owing to the different distribution of masses and head resistance it is very different structurally, and presents a different problem in stability and control.

There are many more variations of float shape for this type than for the boats. The principal divisions are the twin-float and the single-float, of which the twin-float is the most popular, at least in this country. Both single and twin-float types can be further divided into the single-step and two-step classes as are the boats, with an additional intermediate type with a single-step but with a buoyancy chamber or extended stern of the float aft of the step which provides complete or partial fore and aft stability on the water but exerts little or no hydroplaning effect. This pattern is intended to combine the advantages of the single-step as to control of the attitude on the water and of the two-step for stability when adrift. An interesting example of this type is the Brandenburgh float, much favoured by the German designers during the war in which the stern of the float is extended aft and terminates in a vertical stern-post in distinction to the flat or V-shape.

Twin-floats, except for a few experimental machines, have not been built or used so much in the large sizes as the boat type, but owing to certain particular advantages, are popular in sizes up to about 6000 lb. gross weight. It is interesting to note that the twin-float type was favoured in Germany during the war to the almost entire exclusion of every other class. In England it was much used for special purposes, but in France and Italy the boat type has been shown preference. In America, judging by the great variety built, preference seems to be equally divided, but large twin-floats have not as yet been developed, and so no comparison can be made with contemporary large boats.

The only modern representative of the single-float type in this country is the Parnall "Puffin" amphibian, which is a special purpose machine, but in America a considerable variety of single-float machines are built. Although this type has a small advantage over the twin-float in structure weight percentage, it has the serious disadvantage of lateral instability on the water which necessitates the use of large wing-tip floats.

Special examples of float machines are the large experimental Dorniers built in Germany during the war, and one large experimental example built by the Admiralty in this country.

Another principal distinction between boat and float types is that whereas the boat at least in large sizes must have a V-bottom for shock absorption on landing the great majority of float types have flat-bottomed hydroplaning surfaces, the necessary shock absorption being obtained by springing the floats relatively to the machine.

Generally speaking, it would appear that the average advantage lies with the float types for small machines and the flying boat type for large machines, but this point of view must be modified if any one feature of either type is desired in preference to an average of superiority. Also this choice has one serious drawback, as both the single-engined float and the multiple-engined boat types have unprotected propellers, a feature which involves considerable difficulty in the design, and is the principal objection to both types. The chief divergence of opinion is in the question of seaworthiness, and here it is that thorough full-scale experiment could do more than debate. At the same time it is suggested that the two types are not really competitive in most respects, and that both will survive for their special purposes.

There is an idea growing common that British designs lead the world. There is enough truth in such a statement in relation to the structure and performance of British machines to make it dangerous to future progress. Design and construction of experimental machines is only a part of the problem. Principles can be established by research, and the arrangement and construction of machines more or less perfected in a few examples of machines; but before seaplanes or aeroplanes become practical propositions, whether for naval, military, or commercial purposes, they need a long stage of development. Only practical experience of conditions in operation will provide the designers of the country with data on which to improve still further all classes of machine, and there is not nearly enough information of this kind available. This remark applies more to seaplanes than to general aeroplane design. Questions of seaworthiness, handling, &c., can only be solved by full-scale experiment. Even after ten years of seaplane flying there has as yet been no proper comparison made of the relative seaworthiness of various types. Such questions as landing and handling in rough seas are still largely a matter of speculation. A great step in this direction has been made by the recent formation of the Development Squadron of the Royal Air Force, and this scheme should provide exactly what is wanted by the designers if carried out on a sufficient scale.

It must be remembered that during the rapid development of the war years the seaplane benefited constructionally by the harder conditions it was obliged to face. To a certain extent it may be said that the aeroplane was improved by enlarging and rolling the surface of the aerodromes. The seaplane having sea conditions to face naturally evolved as a sturdier structure, and these harder conditions account in part for its greater structure weight, but it has now reached a stage when designers are definitely awaiting data before proceeding. They need experience of the large types already built before going on to still larger examples.

With reduced structure weights and larger machines the range will be greatly increased, and although by flying overland commercial aeroplanes may shortly reach India and Australia, if communications are to be established throughout the Empire without crossing foreign territory, this work will have to be done by seaplanes, and with proper development I suggest that they are the most promising apparatus for the purpose.

* Paper read at the Third Air Conference, Feb. 6th. Abstracts.

Works Production.

A PAPER on "Works Production" was read before the Institution of Electrical Engineers by Mr. C. H. Nelson, on Thursday, January 18th. The special problem of the manufacture of electrical apparatus, the author states, is so complex that it cannot be left to haphazard methods, for there is no apparatus made in which there is a greater variety of materials. In addition to the various ferrous and non-ferrous metals, there are insulating materials, such as mica, paper, linen, cotton and silk in various forms, as well as string, fibre, asbestos, &c., and numerous varnishes and solvents. These involve the employment of all types of labour, skilled and semi-skilled, in many different trades. It is shown that in a rotary converter there are no fewer than 4582 parts, exclusive of nuts, bolts, washers or rivets.

To achieve success in the manufacture of machinery of this kind on anything approaching a large scale, it is essential, the author asserts, that the works organisation should be subdivided into distinct sections, each section having clearly defined functions. These sections are designated:—(A) Design; (B) works superintendence; (C) technical process department; (D) rate fixing and mechanical process department; (E) production department; (F) inspection department; and (G) costing department. A diagram in the paper shows the relationship of these sections.

The system of working described in the paper is said to have resulted in marked economies. The average time of manufacture of a certain size of machine, for example, was reduced from twenty-two weeks to eighteen weeks, and that of other sizes of machines was reduced relatively. This saving in time has recently been further increased, but this is accounted for by the fact that the shop is now fully employed. Other advantages which resulted from the introduction of the system were that the number of machines overdue was reduced two-thirds, and the number of defects was reduced by the same amount, the accumulative effect of all the advantages of the system being to reduce the cost of manufacture by a considerable percentage.

The author considers that a design of each part of a piece of apparatus should be considered at a meeting attended by the designer, the manufacturer, and, if necessary, the salesman, before it is finally made, in order that the requirements of each party may be taken into account. The author refers at some length to the education of the workers, and contends that the training of apprentices should include lectures in economics, and that these and other lectures should be extended to the fully paid workmen. The setting up of a works committee has been found to be the most effective way of establishing confidence between the management and the men, as in this way the management's views on all sorts of questions can be brought before the workers, and it enables the management to obtain the worker's views. In order to stimulate the foremen's maximum interests in the management of their shops and keep them informed on economic and managerial problems, the author has found that monthly foremen's meetings, at which all problems of general interest met with during the month are discussed, are of great assistance. Foremen have, it seems, referred to the value of these meetings, and to the fact that by this method they have received information on matters which in the past have not reached them at all.

It is considered that the greatest obstacle to rapid production is the fear on the part of workpeople that it will lead to unemployment. A man working under these conditions, the author contends, is naturally tempted to take all possible steps to delay loss of employment, and it is suggested that the creation of a special fund to carry the workmen over periods of depression would remove the detrimental effect of fear of unemployment. In view of the fact that many of the problems connected with the manufacture of electrical machinery cannot be left to the shops to solve the technical process department is considered to be a necessity. The duty of this department is to study these various problems, and to issue such instructions as may be necessary to everybody concerned. In addition, the paper states, records must be kept of the various processes' specifications.

In order to take advantage of the full capacities of the machine tools and of the improved methods which are frequently introduced by the mechanical process engineers in collaboration with the tool drawing office, it is desirable that the mechanical process department should consist of two distinct branches. One branch should deal almost entirely with time studies of the feeds and speeds, which can be obtained with the improved methods and appliances and should thereby supply data to the other branches, consisting of the process engineers. In this way, the paper states, it is possible to insure that all piece work times are arrived at on a definite basis with respect to feeds, speeds, &c., and it is therefore possible to eliminate the startling discrepancies which are often found to occur in connection with those rate-fixing systems in which the individual is allowed to express his own personal opinion. The process department compiles a process sheet for every item for which a drawing is made.

In the section on the production department the author expresses the opinion that the works manager should direct and control the operation of the department through the chief of that department in order to insure that it is not systematised beyond practical and commercial limits. The function of the costing department, described in the paper, is to assist the manufacturing section by giving such figures and general help as will prevent excess costs occurring. Finally the author shows the relation of output and cost of production.

THE USE OF MODELS IN ENGINEERING.

IN a lecture given to the graduates of the North-Western Branch of the Institution of Mechanical Engineers, by Professor Gibson, on Thursday, the 8th inst., the author emphasised the fact that a scale model only reproduces the behaviour of its original when the conditions of operation are truly similar in both. Conditions which at first sight appeared to be similar might, he said, lead to results which were altogether misleading, and there were conditions under which the model could be made to reproduce the behaviour of the original. Professor Gibson dealt specially with the application of models to problems involving motion. He illustrated this case by reference to aeroplanes, and evolved an expression from which, given an experimental determination of the resistance of the model at any one velocity, the resistance of a full-sized machine at any other velocity and in air of any other density or viscosity could be calculated.

Quite apart from its application to model work, the author said that the principle of dimensional similarity was often of great assistance in engineering investigations, and its value was not by any means confined to dynamical problems. A simple dimensional statement of a complex problem would often indicate the possibility of obtaining a closely approximate solution by the elimination of one or more factors whose effect was seen to be small, and, as a preliminary to experimental investigation, it would often suggest the easiest way in which to get the required information. While such a statement did not supply any new facts, it might throw a new light on facts already known, and often indicated the possibility of analysing and co-ordinating what might otherwise appear to be a mass of confused or contradictory data.

In many cases the results of an experimental investigation could only be expressed by an empirical formula or such a formula, if it was to be capable of use outside the range of the experiments to which it referred, should always be dimensionally correct. If not, the formula could not possibly be generally true, and though it might satisfactorily represent the data obtained from the particular experiment in question, great caution should be used in extending its range.

THE *Monthly Circular* of the British Cast Iron Research Association says that in the United States the work of the national cast iron research body has resulted in a marked improvement of quality; considerable reduction in operating costs; the formation of the "research habit" in each plant organisation; and a tendency to do better work exhibited by all who have responsibilities in production.

Railway Matters.

THE Grand Trunk is to be so completely absorbed into the Canadian National Railways that it is to lose its name.

THE number of men employed at the Swindon works of the Great Western Company is 13,500. In 1876 it was 4500.

COACHES that belonged to the Midland Railway are now being used in the service between London-road station, Manchester, and Euston.

AT the annual meeting on Wednesday last of the Institution of 'Railway Signal Engineers, Mr. R. J. Insell, the Vice-president, was elected the President for the present year. Mr. Insell is the chief assistant to the signal and telegraph engineer, Great Western Railway.

A SERIOUS collision occurred at the north end of Retford Station on Tuesday morning last. Whilst a goods train was shunting it was run into by the East Coast night express from Aberdeen and Glasgow to King's Cross, due to leave York at 3.32. The driver and fireman of the express and an inspector riding on the footplate were unfortunately killed.

BY a clerical error the capacity of the present 16ft. wagon was given in our leading article on the "British Railway Wagon" last week as 322 cubic feet; it should have been 382ft. In a few lines further on mention was made of tests of wagons carrying a load of 1000 tons. The wagons under test were 50 tons and 10 tons. The latter figure was given as 20 tons.

THE number of passenger journeys during November was 4.6 per cent. less than in November,1921. Those carried at full fares were 11.9 per cent. less and the number of workmen was 4.1 per cent. less. The journeys at cheap fares were 68.5 per cent. more. The receipts from passenger fares decreased 6.8 per cent., but the passenger train mileage was 5.3 per cent. higher.

SOME interesting figures as to the operations of the telegraph department of a railway were recently given by Mr. E. J. Collier before the Bristol Section of the Great Western Railway Lecture and Debating Society. On that line there are 1980 speaking telegraph instruments and 205 speaking circuits and 11,500 telephones—exclusive of 1200 Post Office telephones—and 1650 telephone circuits. The number of telegrams originating was 3,159,511 a year and the number dispatched, received and transmitted was 9,284,472.

ACCORDING to a message from Berne the Swiss Federal Council has been investigating the question of the Furka Railway, which, as is known, has not been completed. The works finished up to the present represent a cost of 30,000,000 francs; 7,000,000 francs more are needed for the completion of the line. In view of the strategic importance of the railway, the Federal Council would not object in principle to the granting of a subsidy, but it would do this only on condition that the Valons and Grisons cantons also contributed towards the scheme.

SINCE 1857, except during the war, there has been an annual reunion of the salaried staff of the Midland Railway Company. It has taken the shape of a ball, at which the directors have been present and the chief officers have acted on the committee. The last was held on the 2nd inst., and we are led to mention the occasion because of the programme then used. It showed a Midland engine standing on a loop line in the rear of a pair of points. Ahead of the points was a short "lead" with buffers at the end. This "lead" was labelled "Midland," and the buffer stops "Finis." The outlet, though, was lettered "London, Midland and Scottish," and the idea was artistically and clearly conveyed that by the latter the Midland would continue its journey.

A VERY valuable safeguard for traders is contained in Sec. 30 of the Railways Act. The constituent companies are to submit to the Railway Rates Tribunal a schedule of the standard charges proposed to be made by each group. These are to be given in accordance with Schedule 4 of the Act, and therein lies the value to the trader. The schedule of charges was to be submitted by December 31st last, but the companies asked for more time. It is now announced by the Ministry of Transport that, after very careful enquiry and consideration of all the circumstances, the Minister has agreed to the application on the understanding that the companies will submit the schedules by June 30th without fail, and that they take every possible step in their power with a view to an earlier submission.

THE Ministry of Transport Requirements for New Railways specify that on gradients steeper than 1 in 260 there shall be runaway catch points a train's length in the rear of the home signal. These points consist of a single trailing switch in the left-hand rail which is normally open so as to derail any vehicle that runs back. Each wheel passing through it in a trailing direction closes it against a spring and the spring forces it open again as the wheel passes on. The utility of these catch points was exemplified on Thursday, the 25th ultimo, when twenty-four wagons and a brake van left on the London, Midland and Scottish Railway at Huddersfield, ran back towards Longwood passenger station, but were derailed at the catch points south of that station. Catch points would not be necessary were freight trains equipped with continuous brakes.

THE retirement, as from the 31st ult., of Sir William Marwood, not only robs the Ministry of Transport of a valuable Secretary but the railway companies of a good friend. Very often has Sir William acted in a conciliatory respect when disputes have arisen between traders or public bodies and the railway companies. He gave evidence on behalf of the Board of Trade before Mr. Russell Rea's Committee on Railway Amalgamations and Agreements and before the Loreburn Royal Commission on the Relations between the Railways and the State. He was a member of the committee presided over by Sir William Collins that began an inquiry into accidents to railway servants. When war broke out all the arrangements for the Government control of the railways were made by Sir William on behalf of the Board of Trade, and he was, therefore, a very important witness before Lord Colwyn's Committee on the companies claims.

Notes and Memoranda.

A NEW type of apparatus for loading coal on board ships, which is being tested on the Clyde, consists of a main frame, a turn-table, and an adjustable shoot, and is placed in position on a vessel's hatch by means of the hoist frame. The coal passes down this shoot through the hopper, and is directed by the shoot under the deck. By revolving the turn-table the mouth of the shoot can be placed so as to deliver the coal in any position in the hold, and as the quantity of coal increases and rises in the hold the shoot itself can be raised and kept at whatever height may be necessary.

THE new bridge across the Mississippi River at Minneapolis is claimed, in the *Engineering News-Record*, to be the longest masonry arch in the world. It is, however, actually built of reinforced concrete. The main span is 400ft. wide by 88ft. high, and is flanked by two other arches of 199ft. The main ribs are 16ft. through at the springing and 8ft. at the crown. They are spaced 25ft. apart in the clear, and thus could be constructed one on either side of the existing steel bridge while the latter was still in service. The old bridge had, of course, to be removed when the floor of the concrete structure was put in place.

IN connection with an accident in a timber yard, which caused the death of a workman, Mr. H. Burney, H.M. Inspector of Factories, commented on the annealing of sling chains. He had examined the broken link and found a crystalline fracture, showing that the link was made of bad iron, or, if it was good originally, that it had been badly treated in the fire. The safe working load for a chain of that size was three-quarters of a ton. Persons who did their own annealing put chains, he said, in a smith's fire, which was not the proper method. Annealing should be done in special ovens so as to ensure against overheating. There were firms who specialised in annealing, and who used special furnaces. Annealing in ordinary smiths' fires did more harm than good.

WHAT is considered to be the largest testing machine in the world has been in use for several years at the branch laboratory of the United States Bureau of Standards in Pittsburgh, and has recently been moved to the main laboratory of the Bureau in Chevy Chase, a suburb of Washington. The machine is to be used for testing the specimens for the towers of the Delaware River Bridge, now under construction at Philadelphia. After that it will be used on the remainder of 72 steel columns which w re being tested at Pittsburgh. The specimen to be tested is placed in the machine by an electric crane capable of lifting 20 tons. The upper head is brought down until it rests on the specimen and the load applied by a large hydraulic jack built into the lower head. The piston of this jack, on which the specimen rests, is lifted by oil forced into the cylinder under a pressure of 5000 lb. per square inch by a motor-driven pump.

THE Board of Trade has issued a pamphlet containing standard conditions for the design and construction of water-tube marine boilers. These conditiins were framed by a conference constituted of representatives of the Board of Trade, Lloyd's Register of Shipping, the British Corporation for the Survey and Registry of Shipping, and the Bureau Veritas, and were, as in the case of the standard conditions for cylindrical marine boilers, published in 1920, based, to a very large extent, upon the recommendations of the British Marine Engineering Design and Construction Committee. The Board of Trade is indebted to this Committee for the very valuable work which they carried out. It is hoped that the results of this work will enable an appreciable advance to be made in the direction of standardisation, and that the unification of the Boiler Rules of the Board of Trade and the three classification societies named will greatly facilitate the design and manufacture of marine boilers in this country.

IN the quest for petroleum, says the United States Bureau of Mines, probably thirty million dollars are spent yearly in the United States in drilling operations which result only in dry holes in the ground. In a period of two years, 5814 dry holes were drilled in the country at an average cost of at least 10,000 dollars per hole. California and New York show the lowest percentage of dry holes of all the oil-producing States. Texas shows the highest percentage of dry holes, undoubtedly because of wild-cat drilling. Oil and gas have been found in at least twenty-three States and Alaska. In prospecting for oil, the theory that gas comes from oil is not reliable without corroborating evidence. Fields yielding no oil produce gas in large volume. The Monroe gas field of Louisiana, the largest gas field in the United States, has produced no oil, although the petrol content of the gas is 100 gallons per million cubic feet. In other fields gas is found in a reservoir separate from the oil. Frequently, as in parts of the Midway field, California, the gas occurs at different statigraphic depths over a given area, and efforts to correlate these gas sands in well cross sections are fruitless. Again, a sand may yield oil and gas in one part of a field and give gas only in another part.

THE Commercial Secretary at Stockholm—Mr. H. Kershaw—has informed the Department of Overseas Trade that the annual report of the Swedish Ironmasters' Association shows that the year 1922 was a very difficult one for the Swedish iron and steel industries, although on the whole it compared favourably with the previous year. According to statistics, there were on December 31st 32 blast furnaces working out of a total of 130, against 22 on December 31st, 1921. Out of 204 Lancashire hearths 53 were in operation, as compared with 37 in 1921, 3 Bessemer converters were working out of 18, compared to 5 the previous year, and 24 Martin furnaces out of 82, against 15 a year ago. Towards the end of the year, the demand for iron decreased, and in December alone 4 blast furnaces, 12 hearths, 7 Bessemer converters, and 11 Martin furnaces were drawn. The total production during the year amounted to 259,700 metric tons of pig iron—about 35.5 per cent. of the 1913 production—as compared with 314,400 tons in 1921; 342,900 tons of ingots and blooms—46.1 per cent. of 1913 production—compared with 236,000 tons in 1921, and 212,700 tons of rolled and wrought iron—corresponding to 61.5 per cent. of the 1913 figure, compared with 127,200 tons in 1921.

Miscellanea.

INDICATIONS of the existence of petroleum in the Kuruman District of South Africa are reported in the *Northern News* of Vryburg.

A TELEGRAPHIC line between the Kilo region in the Congo and the British telegraph system in Uganda has been completed, and communication was established on Jan. 15th.

SOME tests have recently been carried out in France with a car designed for the use of heavy oil—gas oil—instead of petrol. Two cars were used identical in every respect, except that one had a 15 horse-power oil motor and the other had a 15 horse-power petrol motor. The cost of fuel for the car run by petrol is said to be four times greater than that of the car run by heavy oil.

THE Grocers' Company is offering a scholarship—one of three—of the yearly value of £300, with an allowance for necessary expenses, the object being to encourage original research in sanitary science. The appointment will be for one year, but it may be renewed for a further second or third year. The election will take place in May next. All applications must be sent before April 1st to the Clerk of the Grocers' Company, Grocers' Hall, E.C. 2, upon a special form obtainable upon application.

ONE of the first operations following the recent decision to expend 100 million francs over the next ten years upon improvements to the Suez Canal, is to be deepening it to a depth of 32ft. instead of 31ft. This work is to be completed by the end of the year, and as soon as possible the depth will be increased to 35ft. The banks are to be 60 m. instead of 45 m. apart. The sea channel at the Port Said end of the canal will be deepened correspondingly, the work being more permanent by reason of the new breakwater being extended so as to prevent sand falling in from the north-east.

IN allotting space for engineering exhibits, the Exhibition Organising Committee of the British Engineers' Association has prepared a plan based on the grouping of the various exhibits within the building, in accordance with a classification that will enable the buyer to ascertain exactly where the products he is seeking will be found. The promenades between the stands will be numbered in a sequence of avenues and streets, and exhibitors' stands will also bear proper sequence numbers, so that every stand will have its own postal direction within the section, which will enable visitors and buyers to find their way direct to the stand of a given exhibitor without difficulty.

THE Minister of Health has appointed the following representatives of the British Waterworks Association and the Institution of Water Engineers as a standing advisory committee to confer with representatives of the Ministry on questions of water supply:—Mr. C. S. Musgrave, Mr. A. R. Atkey, Mr. A. B. E. Blackburn, Lieut.-Colonel J. R. Davidson, Mr. F. W. Macaulay, and Mr. W. Terrey. The subjects discussed at the committee's first meeting included:—(1) The steps to be taken for formulating the outlines of a national water policy; (2) the survey of the water resources of England and Wales; and (3) the standardisation and testing of water fittings.

AN offer has been made by a private concern in Sydney to develop the Carol's Gap limestone deposits in partnership with the New South Wales Government, so that all the cement requirements of the State Government may be met. It is calculated that in the near future over £500,000 worth of cement will be required for great new works. It has been proposed that a company with a nominal capital of £1,000,000 should be formed, and of this sum the Government should guarantee £600,000, the remainder to be floated in London. Probably the Government would not have to provide any actual cash, but would obtain a holding in the company in return for the lease of the limestone country, which is Crown land.

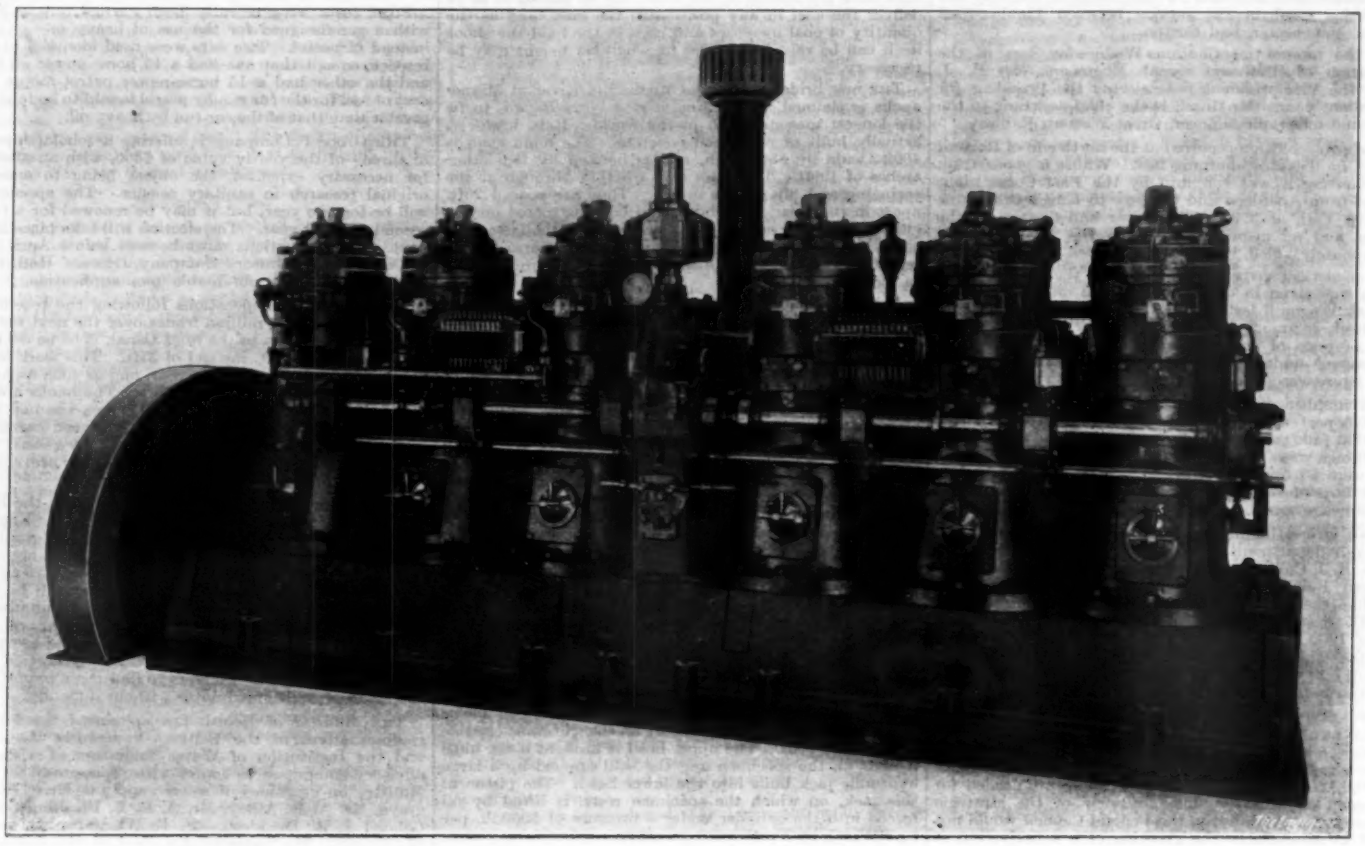
AN interesting lecture on "Circuit Breakers *versus* Fuses," illustrated by lantern slides, was recently delivered by Mr. J. Anderson in the works mess-room of George Ellison, at Perry Barr, before an audience of about 200, comprising members of the staff, students from Birmingham University, and some local industrial engineers. The lecturer gave the results of tests which showed that the usually accepted figures for fusing currents of wires are wrong; and a new table of fusing currents for copper wire was shown. The absence of reliable data regarding the breaking capacity of fuses was emphasised, and it was held that dimensions for the magnetic blow-out type only can be calculated for any desired breaking capacity. In connection with automatic circuit breakers, the lecturer presented a table of factors influencing the breaking capacity, and gave laws to enable a breaker to be designed for any required breaking capacity. Types of switchgear in use twenty to thirty years ago were illustrated to show that little progress has been made in the interval on the design of fuses and circuit breakers. Progress in switchgear, it was pointed out, has been more in the multiplication of protective devices.

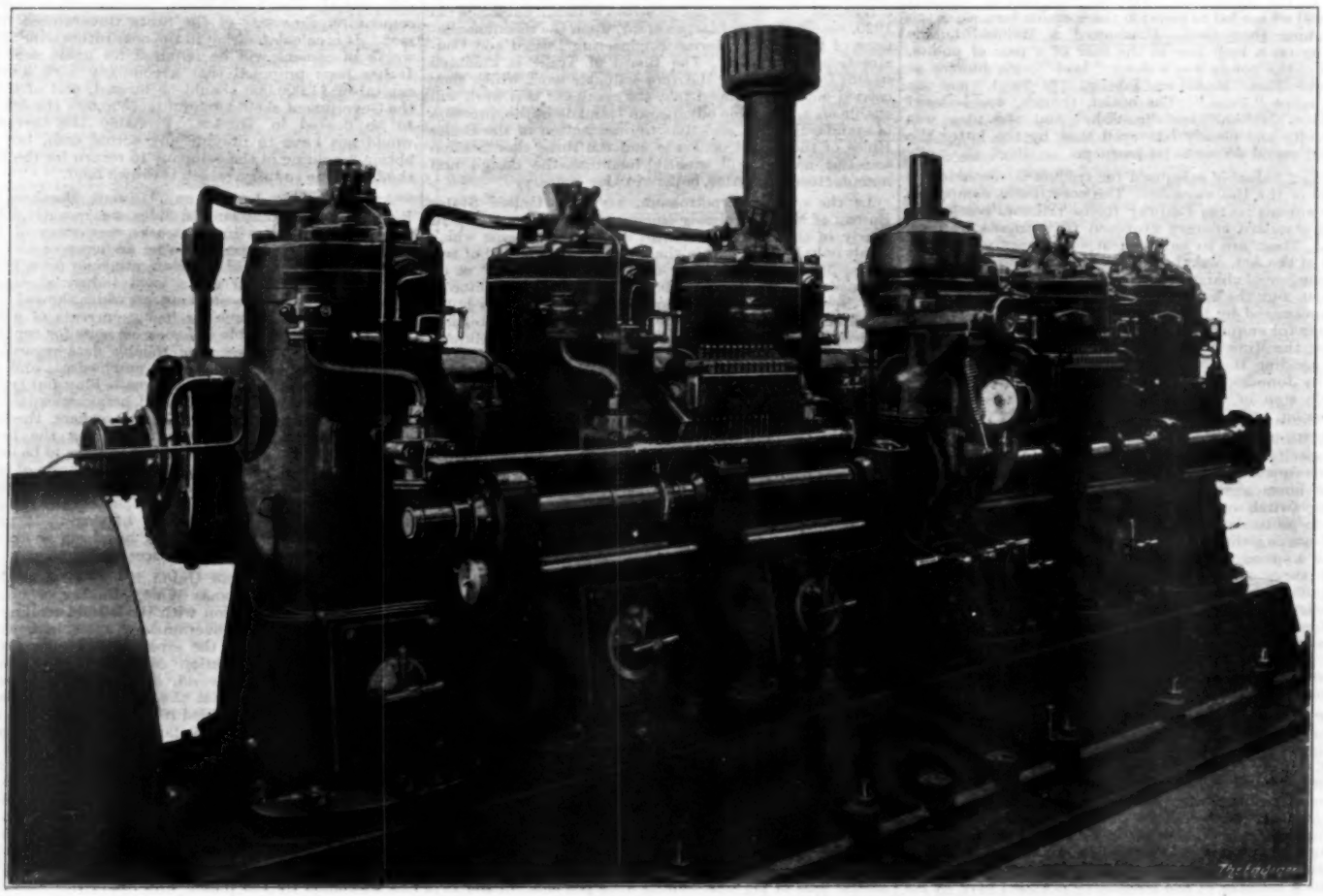
IN the South African Union House of Assembly, on January 31st, Sir Thomas Watt, Minister of Posts and Telegraphs, in connection with the second reading of the Bill confirming the Government's agreement with the Marconi Company for the erection and operation of a high-power wireless station capable of communicating with any part of the world, outlined the agreement in question. He stated that the company had been given the choice of a site provided it was not within the zone of gunfire from the sea, but as far as he was aware the company had not yet definitely selected a site pending Parliament's approval of the agreement. Sites in various parts were under consideration. The rates on messages would be one-third less than existing rates charged by the cable companies for similar messages, for example, to Great Britain, full rates will be 1s. 4d. per word; deferred and Government messages, 8d. per word; and press, 2½d. per word. These favourable rates, added Sir Thomas, would be welcomed by the public who found the cost of cable messages a heavy burden and sometimes quite prohibitive. No doubt one result of the agreement would be to stimulate competition between the cable companies on the one hand and wireless on the other. It was possible, therefore, that the above maximum rates would not be maintained by the company.

SIX-CYLINDER TWO-STROKE CYCLE OIL ENGINE

PLENTY AND SON, LIMITED, NEWBURY, ENGINEERS

(*For description see page* 180)





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DEATH.

On the 13th inst., at Stanhope-gardens, Queen's Gate, of pneumonia, after a short illness, ADAM SCOTT, M. Inst. C.E., of 91, Victoria-street, Westminster, aged 68.

THE ENGINEER.

FEBRUARY 16, 1923.

The Indicator.

A SYMPOSIUM of technical papers has always the defects of its merits. It places so many subjects before the audience that discussion tends to become sketchy and diffuse, and, as a rule, has to be cut short before all the speakers have had their say. That was the fate that overtook the four papers on "Indicators," which were presented for discussion at the Institution of Mechanical Engineers on January 19th, and on which the discussion was resumed last Friday. A better public debate might have been conducted round any one of the four than round the four together; but, on the other hand, it is probable that the written discussion on the group will, on account of its greater width, provide a more complete survey of the whole field of indicator engineering than a debate on any one of, at least, the three descriptive papers would have done.

It was a little regrettable, perhaps, that nearly all the speakers dealt either with optical indicators or with micro-indicators, for it is with the familiar piston indicator in one or other of its numerous forms, that engineers have usually to deal. The optical indicator is still, after many years of development, an instrument of the laboratory, and the test room, and if it is ever to move from that position it will have to be greatly reduced in price, in size, and in delicacy. There has, indeed, been very marked improvement in the design of instruments of the kind, and the two latest forms of the Dalby-Watson and Burstall are thorough engineers' jobs, but they are costly, and are likely to remain so. We understand that the Crosby Gauge and Valve Company hope to put the Burstall indicator on the market for about a hundred guineas or so, and the Dalby-Watson, made by Mr. Cussons, of Manchester, can hardly be produced at a much lower figure, even without the epicyclic phase-adjuster, which is a valuable adjunct to it. Ordinary piston indicators vary roughly between, say, fifteen and twenty pounds apiece, with a set of springs. On all these grounds it is pretty safe to assume that the optical indicator will never displace the mechanical indicator for moderate speeds, and if a mechanical indicator suitable for employment on petrol engines can be invented, the optical instrument will never be found outside the research laboratory. For this reason particular interest attaches to the micro-indicator of Mr. Collins, which offers one solution of the problem. It is an extremely attractive instrument, concerning which only one serious question can be raised—the influence of the scriber friction on the celluloid disc. It appears to be extremely small, but we suggest to the makers, the Cambridge Scientific Instrument Company, that they should, for test purposes, use a very thin hardened steel disc, and take diagrams by smoking its surface. By contrasting such diagrams with those made by the same engine at the same time on a celluloid disc, an idea of the magnitude of the stylus friction should be found. The minute size of the micro-cards is an apparent rather than a real objection—for they can readily be examined under a lower power microscope—save that it is obviously impossible to measure them with a planimeter. For this purpose they must be magnified by optical projection. It is interesting to observe that, when that is done, the micro-indicator is very closely related indeed to the optical indicator. In fact, it may be regarded as an optical indicator in which the optical magnification is carried out in a separate apparatus. An interesting point, which we were glad to hear developed, is the effect of inertia in optical indicators. It was very rightly observed that all such instruments have moving mass, and that though the effects of inertia are extremely small in themselves, they are very greatly magnified by the optical system. Imagine, let us say, a Burstall indicator enlarged in all its parts, till the stroke of its piston was, say, ½in., is it not pretty certain that its moving weights would be much greater than those of a first-class mechanical indicator? If they were, the inertia effects on the cards would be proportionately greater. The comparison is, of course, not strictly accurate, but it is sufficiently so to show that inertia is far from being insignificant in optical indicators. Turning to another aspect of the discussion, we were disappointed that the whole question of the pressure-volume card did not receive greater attention. The diagram based on pressure and piston displacement has prevailed since the days of Watt, and engineers have grown so accustomed to it, that they rarely think of alternative forms. The only outstanding merit of the pressure-volume card is that the horse-power can be directly measured upon it; but, on the other hand, it has the grave disadvantage when used for internal combustion engines, that the important part of the stroke is crowded into the very portion of the card where the displacement is least. That difficulty can be overcome by putting the paper drum 90 deg. out of phase with the piston. The diagram remains the same length, but the important part of the card is drawn out, whilst the less important part is compressed. But a still better plan, for high-speed work, is to take the diagrams on a time basis, as in continuous indicators, and so avoid all the errors associated with the reducing gear, the stretch of the cord, and the inertia of the drum. It is particularly surprising that this principle has never been applied in optical indicators since by its use the optical system could be simplified by omission of the stroke-reducing mirror or its equivalent. That it *is* employed in the remarkable electric indicator, developed by Mr. Wood at the Royal Aircraft Establishment, shows that its advantages for very high speed work are not wholly unrecognised.

The advance in the design of mechanical indicators was shown very strikingly by a curve, in which the weights of the moving parts were put as ordinates against gears as abscissæ, but it is not only in the reduction of inertia that improvement has been effected. The influence of pencil friction had long been known, but the serious effect of piston friction was more tardily recognised. One of the factors conducing to this friction is spring distortion, which thrusts the piston to one side, and in the most recent designs the Crosby "New," the Maihak and the Lunken—the last two German instruments designed by Lehmann and very similar in character—and in the new instrument which Dobbie McInnes and Clyde are shortly putting on the market, this effect is reduced by employing a spring in tension in place of one in compression. It would be unsafe to say that a tension spring, rigidly held at one end, cannot distort laterally under load, and in the Crosby we find a spherical piston employed to prevent any possible binding effect from lateral movement of the piston-rod. But if any such distortion does occur, it will certainly be far less than the distortion that may arise in a compression spring. Hence the tension spring must be regarded as a distinct improvement. But it is far from being the only one, and all who examined the fine collection of indicators at the Institution of Mechanical

Engineers, must have been struck with the excellence of the design and the beauty of workmanship of the exhibits. It is surely a remarkable thing that an instrument of great delicacy and precision has been brought down to a form where it is robust enough to stand the rough handling of an engine-room, and yet precise enough to give in the hands of an expert results which may be safely estimated as accurate within an error of not more than 5 per cent.

Mechanical Engineering and its Materials.

IN the introductory passages of the excellent paper which was delivered before the Junior Institution of Engineers on Friday last, Professor F. C. Lea opened up a view of the progress of engineering which not only includes the greater part of the past history of that art and science, but foreshadows a still greater part of the future. "The history of the engineering developments of the nineteenth century," he said, "can almost be summarised as the history of the discovery and development of a few fundamental ideas made of practical use by the antecedent or subsequent developments in material." Professor Lea selected that period when, with the invention of the rotatory steam engine, the modern industrial era began; but had he looked even further backward he would still have found justification for his statement. If he had then turned his eyes to the future he would have seen the justness of his opinion grow ever greater and greater as man exhausted all possible mechanical combinations and was forced to rely for further advancement solely upon changes in the nature of the materials with which old ideas were made to keep pace with the needs of that day. Watt, it is true, as Professor Lea said, was hampered by the difficulty in finding suitable materials for his purposes; but we must not forget that he was certainly not less hindered by the lack of means to perform many workshop operations which are now commonplaces—as, for example, the accurate boring of cylinders. In no branch of mechanical engineering has there been such marked advance as in workshop methods, and it may be said that even now there are few mechanical operations—not exceeding rational possibility—which cannot be performed rapidly and accurately, and in a few years time there will be none at all. We have perhaps not advanced quite so far towards exhaustion of those fundamental mechanical movements which we combine in various ways to produce "inventions," but we are certainly approaching it. Such radical inventions as levers, screws, gear wheels; the flying machine, the screw propeller, the steam turbine; roller spinning, rotary printing mechanical harvesting, and so on, become more and more rare, and it is already rather in the opportunities which are given to us by new materials that we look for improvement than in complete originality of design.

The more closely we study the history of mechanical engineering the more it is borne in upon us that the early engineers knew very nearly as much as we know to-day about mechanical subjects. It was not incapacity to invent many of the machines with which we to-day are familiar, but the lack of need for those inventions that restrained them. Had Nasmyth, Smeaton or Roberts lived in the period when the coming of the safety bicycle called forth a remarkable development in machine tool design, they would have held their place with the best nineteenth-century makers; and had Parsons lived in the times of Penn, Maudslay, and Napier, he would have found them as well able to develop his ideas on a practical scale as any modern steam turbine builder. Mechanical engineering is fundamentally simple. It is founded upon "laws" which are of the easiest comprehension, because they are no more than the extension of familiar experiences which can be readily tested by ordinary human senses. It is only when we leave the purely mechanical and enter the realm of physics that we meet with problems that cannot be solved by the evidence of the eyes or the fingers. We make this point because it leads to the same end that Professor Lea had reached—that for further developments of mechanical engineering it is to improvements in materials that we must look. Even when we turn from the purely mechanical and consider the physical we find that we have now at command an array of physical knowledge sufficient to achieve vast progress as soon as the nature of available materials permits. What illimitable prospects, for example, will open before the discoverer of a metal with the physical properties of steel, but with the coefficient of thermal expansion of Invar? Again, our physical knowledge is sufficient to enable us to construct an internal combustion turbine of very high efficiency, but advance in that direction is limited by the inability of any available metals to withstand the combination of high stresses and exalted temperatures. Consider the development of high-pressure steam engines. A hundred years ago Trevithick appreciated the value of high pressures, and the thermo-dynamic importance of it was in some measure understood by Jacob Perkins and almost wholly by Loftus Perkins. Had any of these engineers been able to command the materials which we now command—including in this connection lubricants—they would have employed pressures as high or higher than the highest we now use. If space were available to survey the whole field of mechanical engineering, we should find examples multiplying rapidly under our hands to verify and augment Professor Lea's statement.

When we consider the advancement of mechanical engineering from the aspect we have endeavoured to present, the value of the relatively new science of materials becomes doubly clear to us. Engineers betray sometimes a little impatience with metallurgists, whose "jargon" they but imperfectly understand, whose methods they condemn as "laboratory," and whose ideas as "academic." Yet let us admit that they are working in a field more difficult than ours, a field where the ordinary senses are at fault; where touch is useless and where eyesight must be augmented by the microscope. One by one they have wrested from materials the secrets of their characteristics, broken down empirical rules, and replaced by absolute knowledge the intuition or personal skill of the old-time workers in metals. They are opening up new possibilities before engineers, and though it may be difficult to see sometimes, as Professor Lea said of his own investigation, whither their research is leading, they have a right to invite our trust, because, since the knowledge they have already given the world through researches which in their time had often enough to face contempt, it is fair to hope that further investigation will provide mechanical engineers with even better and better materials to convert into useful machines.

Chinese Engineering Notes.

(*From our own Correspondents.*)

January 2nd, 1923.

Peking.

SUPPLIES for the Chinese Government Railways continue to arrive in this country from America and Belgium, but the Government is unable to take delivery, or, rather, the manufacturers will not release the materials because the Government cannot pay. At the moment there are over 250 railway cars and thirty locomotives lying in storage at Tientsin and other ports, and the railways are starving for rolling stock! One of the main trunk lines—the Peking-Hankow Railway—is literally falling to pieces for want of supplies and repairs, but every cent of revenue, apart from that required for salaries and wages, is going to the military authorities. Nothing is reaching the Ministry of Communications from any of the railways in China, and the date is not far distant when China is going to default on practically all her railway loans. This is the most serious aspect of the situation to-day, and it is really time that the foreign Powers concerned took action. It is pathetic to witness the efforts of the President to form a Cabinet. We have had five Prime Ministers during the last six months, all of whom have had to resign on account of the continued interference by the many independent military factions in North China. Out of this chaos another very serious situation has arisen. The soldiers are getting completely out of hand, and for months have been molesting foreigners. Within the last four months seven foreigners have been captured by so-called bandits—who are really soldiers who have deserted as a result of receiving no pay. Two or three weeks ago an American business man travelling with his Consul in a motor car outside the city of Kalgan, 80 miles from Peking, was fired on by soldiers and subsequently died. Another such incident occurred shortly afterwards on the road between Peking and Tientsin when the Italian Chief of Police at the latter port was fired on by soldiers. Unless very strong action is taken by the foreign Powers we shall have a repetition of 1900.

It is unfortunate that as a result of this unrest the engineering business suffers most because the future of this industry lies in developing the interior of China. Schemes are afoot throughout the country for the establishment of electric lighting and power companies, waterworks, cotton mills, oil and flour mills, &c. &c., but they are being held up because the Chinese pioneers in this class of work are afraid of investing their money in enterprises which may be seized at any moment by the military people. The wealthy Chinese are also getting very anxious about the future and are realising their Chinese securities and putting the proceeds into either foreign banks or foreign securities. This is a state of affairs that cannot go on much longer. The time is ripe for the Great Powers to take a real interest in Chinese affairs, and to assist the Chinese to put their country in order. This, of course, is not an easy task because no one Power is willing to take the lead, but it is now realised that China cannot carry on any longer without real assistance from outside sources. This assistance in the first place must take the form of completely eliminating the influence of the independent military factions throughout the country. The engineering and manufacturing firms in England cannot afford to see this country disappear as a market for their products, but it is useless trying to save it by means of financial assistance. It is too late for this. What we want now is a powerful International Conference in China on the lines of the Washington Conference. The whole of the country and the Press would back up such a Conference, especially if its first aim was to eliminate the military people. It is possible that these Super Tuchuns (Military Governors) would leave the country when they realised that the Powers, backed by the Chinese people, themselves really meant business.

Shanghai.

In spite of political unrest in the country, one cannot help feeling a certain amount of optimism about the prospects of trade in the Treaty ports of China. There is every indication of a better state of things approaching in the industrial world, as far, at least, as the Treaty ports are affected, but the conditions in the Treaty ports do not, however, indicate the true state of affairs in China. In this port, for example, many wealthy groups of Chinese, who intended to build exchanges wherein to gamble in various industrial stocks, have decided to put their money into the building of large hotels with several hundred rooms and dancing halls, or into the building of factories for the manufacture of various goods which have hitherto been imported. Such intentions indicate a growing demand for a higher standard of living, and point to an increase in foreign trade, for when the Chinese show a desire to live as we do there will certainly be an augmented demand for foreign-made goods. It is true that, as in the case of Japan, where they now manufacture practically all the country's requirements in the way of clothes, food, and household necessities such as building materials and hardware, the Chinese are advancing to that self-supporting state of affairs in respect to purely domestic articles, but with that advance the demand for industrial machinery increases, and it will be some time before the Chinese can turn out satisfactory machinery such as that required in the manufacture of textiles, or for electric light plants, to instance one or two cases. Hence the country, in supplying its own needs in some directions, must increase its necessities for outside help in others. There is no doubt, as has been indicated before in these notes, that every effort should be made by us to foster any effort on the part of the Chinese to improve their means of communication and transportation. Opportunities occur for doing so in the building of good roads in co-operation with the Chinese outside the foreign settlements. By them a large field for the use of transportation machinery would be opened out, and more land become available at economical prices for factories. An opportunity for a beginning of such an expansion occurs at the present time by co-operation of foreigners and Chinese in building a really good road from Shanghai Settlement to Woosung, the port at the mouth of the Whangpoo River. There are no really good roads at present outside the settlement boundaries. There are cinder roads which are unfit for heavy traffic and which become unfit for any traffic at all after heavy rain. The difficulty hitherto has been that the Chinese feared an infringement of their sovereign rights if they allowed foreigners to construct roads outside the settlements, and the foreign vested interests in Shanghai Settlement do not encourage development of territory outside the Settlement for fear that the value of their property may depreciate. However, when these views can be proved to be parochial by the fact that trade increases with the capacity of Shanghai to afford facilities such as safe transportation and comfort to rich Chinese, progress may be attained. The traffic in Shanghai Settlement is becoming alarmingly congested, and the wheel load per yard of road is greater on some roads in that city than in any of the great cities of the world.

The Geological Survey of Great Britain.

SUMMARY OF PROGRESS FOR 1921.

WHEN the Department of Scientific and Industrial Research was founded during the war as a committee of the Privy Council, it was decided to hand over to its control two old established institutions—the National Physical Laboratory and the Geological Survey, as they represented aspects of science directly or indirectly affecting industry. Thus it comes about

that the annual memoir summarising the work of the officers of the Geological Survey takes the form of a detailed report by the Director, Dr. J. S. Flett, M.A., D.Sc., LL.D., F.R.S., together with the report of the Geological Survey Board to the Lords of the Committee of the Privy Council for Scientific and Industrial Research.

In the past the work of the Survey was primarily, one may say, almost entirely limited to the scientific side of geology, its economical aspects and importance being ignored. During the war period, however, a change took place owing to the necessity experienced for finding our own supplies of various ores and minerals, for which we had been entirely or partially dependent upon imported materials. The change took the form of the economical survey of mining areas, the scientific details of which were known to the officers, and the work that was done, rather too hurriedly we must say in some cases, formed the substance of several special reports on the mineral resources of Great Britain. Some of these reports are now coming out as third editions, while new ones are continually seeing the light, showing that the war-born innovation has come to stay. This is as it should be, and though the expenses of the Survey have naturally increased, we are not in sympathy with those members of Parliament who have cavilled at the expenditure. A point which has been raised by a contemporary is as regards the possible communications of discoveries of importance to individuals who might utilise the acquired knowledge to their own advantage, a special case mentioned being borings for hematite in the Cumberland and Furness area. Now, although it is reported that such borings are being undertaken by the Survey, there is nothing in the report for 1921, published a few weeks ago, to substantiate this contention, though, no doubt, the good offices of the Survey have been invoked by those who are engaged in private enterprises. Whether such offices are or are not being paid for by those primarily interested is a matter on which we can only speculate, but the position is one of some delicacy and needs careful handling in the interests of the general taxpayer, who is contributing willy-nilly to research associations all over the country, and told not to be inquisitive when he asks for details of the work done. In connection with this topic, we may quote the following paragraphs from the report:—"A large number of enquiries on geology, especially in its application to industry, have been received from the general public and commercial firms. The following are a few of the principal subjects: Wells and bores for water, ironstone, peat, concrete, oil-shale, soapstone, sands, coal, soils, mineral oil, china clay, sillimanite, gypsum, road stones, setts, copper and lead ores, barytes, brick clays, precious stones." "Petrographical work in connection with England and Wales has been carried out by Dr. Thomas, chiefly in answer to enquiries from private individuals and Government departments."

In the report of the Geological Survey Board, which is signed by its chairman, Mr. F. G. Ogilvie, reference is made to the increase of staff, to the opening of local headquarter offices in three areas, namely, Manchester, Newcastle-on-Tyne, and Whitehaven, and to the arrangements made for co-operation with the Fuel Research Board in its survey of coal seams from the fuel point of view. Coming now to Dr. Flett's report, it is, of course, impossible to refer to more than a few of the facts and comments with which it is replete. Field survey work has been carried out in Cumberland, Lancashire, and Northumberland, from the local headquarters just mentioned; also in London and district, the West Midlands of England, and in the Scottish Highlands and coalfields. With regard to the Ayrshire coalfield, it is stated that its revision has introduced some important changes in the maps of that district. The lava of Millstone Grit age near Tarbolton has been proved to have a more extensive outcrop than was suspected, but the valuable Ayrshire bauxitic clay, which accompanies these rocks in North Ayrshire, has not yet been found in a workable state on the south side of the Kilmarnock coalfield. We note the term valuable used in referring to this clay, and also that it is described as bauxitic clay and not bauxite. Whether it is to be considered as an addition to our home supplies of bauxite we do not know, but, at any rate, it does not figure as such in our mineral statistics, the only locality from which supplies are drawn being County Antrim, where it occurs in the form of seams lying between sheets of Tertiary basalt.

Another mineral which occurs in the Ayrshire coalfield is graphite, which, though of low grade, was, we believe, marketed at one time. This is another indication of volcanic action. In the Northumberland and Durham district the revision of the Lower Carboniferous tract from Berwick-on-Tweed southwards has been continued, and regarding the northern area it is mentioned that although there is little of the Lickar coal seams left, there is good reason to be optimistic about the future of the Scremerston coal group, where there are extensive reserves still intact at shallow depths. This coal is stated to be soft and dirty, but the opinion is expressed that it should be suitable for power gas and by-product purposes. Fuel technologists may or may not agree with this view, but it is certain that in the future low-grade coals will be utilised in one way or another more than in the past, which has many records of unjustifiable waste. We pass on now in the erratic course of our comments to the field work being carried out in the re-survey of the East Lancashire coalfield, and would call special attention to the following paragraph: "Except in the neighbourhood of Rochdale, where the mines occur at a considerable depth, the coals have been largely worked out." Now, to our mind this statement, with which we are in entire accord, raises the important question as to whether it is worth while going to the trouble and expense of re-surveying an area which for the most part has had its day as far as coal mining is concerned. It may be contended that something of the same sort was once said of the Wigan area, but the conditions are different, and, anyhow, the report does not indicate the possibilities of any new developments. The district generally consists of the Lower Coal measures and the higher divisions of the Millstone Grit, and is much faulted. It will not be wide of the truth to say that all coal within reach has been got, except under Rochdale and to the south. Mention is made in the report of the carbonate of lime deposits locally known as "bullion" on the top of the Upper Foot coal, and we may add that the Lower Foot mine is noticeable for its characteristic roof containing veins of calcite, crystallised carbonate of lime. This, we believe, is unique; at any rate, we have not heard of a similar occurrence elsewhere. Another point of some interest is that in the north-eastern part of the district towards Todmorden, the Upper Foot coal and the Lower Mountain mine join up as one mine. Mine, we may explain parenthetically, corresponds to what is called seam in various other coalfields. There are one or two references in the report to the gritstone of the district. There certainly is plenty of it, and of specially good quality, about Turton and Bacup; the trouble is that the quarrying of it is a dying industry owing to the competition of concrete, and also of granite, which has replaced the flagstones of old times. If the Survey can suggest anything in the way of new markets it would be an economic move of importance.

Before leaving the subject of coal, we make a brief reference to Appendix III. of the report, which contains an account of the interesting boring for coal which has been made at Westbury, in Wiltshire. This boring was started in 1914 in the grounds of the New Westbury Iron Company's works, and was stopped in the following year when the coal measures were struck at a depth of 1526ft. At a total depth of 1651ft. no seams of coal had been struck. Presumably, the prospectors were hoping to find the easterly extension of the Somerset coalfield. After all, 500 yards is no great depth, the main doubtful point, to our mind, about the venture being the thickness and value of the seams if they should be found.

Glancing now at the Whitehaven headquarters of the Survey, we note that good progress has been made with the re-mapping both of the Carlisle and Silloth district and of the Whitehaven district. In the former district special attention has been given to the peat mosses lying north of Carlisle, about 13 miles having been mapped during 1921. Besides being used locally for fuel, the peat is exploited commercially in the Wedholme and Solway mosses for peat moss litter, and in the manufacture of molasses meal, oil cake, manure and brown paper, the Dutch system of cutting being employed in some cases. In the Whitehaven district the outcrop of the Carboniferous Limestone has been examined by Mr. Dixon, and the seven limestone bands recognised by Mr. J. D. Kendall have been found to persist throughout. The importance of this district is in regard to iron ore, and the report states that it is obvious that along this outcrop, where valuable deposits of hematite are being worked, and exploration is being actively pushed northward, a knowledge of sequence and structure is vital to the mining industry, and that conclusions under either head must be preceded by patient accumulation of evidence. The useful work done recently on the lithological and faunal characters of the West Cumberland Carboniferous Limestone series by Mr. C. Edmonds is referred to, and it, we may say, corresponds in some degree to the investigations carried out by Mr. L. M. Parsons on dolomitisation in the Carboniferous Limestone in the Midlands. Some work which is being done at the present time by another investigator on the limestone strata immediately to the east of the Carnforth-Kendal fault also shows the great variation that exists in the magnesia content of limestone within quite a small area.

Going north to the Western Highlands, the principal point of direct economic interest relates to the Raasay ironstone, which has been found to outcrop at Ardnamurchan, on the Argyllshire mainland. The opinion, however, is expressed that owing to the profusion of igneous intrusions there is absolutely no prospect of the find proving of economic importance. Some of the ore in the district has been changed from earthy carbonate to magnetite, but of too low grade to warrant exploitation. The Isle of Raasay workings, we may say, are quite modern, the first cargo of ore having been shipped to Glasgow in 1911.

We notice that though references are made in the report to mineral deposits which have no economic value in the opinion of the Surveyors, there is no notice of discoveries which have, or may be supposed to have, commercial possibilities. To reiterate what we have already said, this was not a matter with which the scientific geologists concerned themselves in the not very distant past. But to-day, as we have said, a wider view is being taken, and it is difficult to believe that all the careful re-mapping work done in the West and North Highlands districts has resulted in no finds of potential economic importance.

We shall be excused, no doubt, for being unable to find space in this journal for any reference to the palæontological work done by the Survey, and will close our review with a brief reference to the Museum of Practical Geology in Jermyn-street, where the number of visitors during 1921 amounted to 26,829. Developments in the exhibits on the economic side include numerous specimens to illustrate the special reports on iron ores, the mining districts having been visited for collecting purposes. Cases have also been arranged to illustrate the uses of refractory materials, abrasives, sands and cements; so it is clear that the Director has every sympathy with those who would increase the scope and usefulness of this proverbially dull institution.

BOOKS RECEIVED.

Handbuch des Dampflokomotivbaues. Von Dr. Martin Igel. Berlin, W. 10: M. Krayn. Price 12s. 6d. net.

The Swedish Year Book, 1922. London: The Swedish Consulate-General in London, Bank Chas., 329, High Holborn, W.C. 1.

Willing's Press Guide, 1923. Jubilee Issue. London: James Willing, Limited, 30, King-street, Covent Garden, W.C. 2. Price 2s. 6d. net.

A Treatise on Weighing Machines. By G. A. Owen. London: Charles Griffin and Co., Limited, Exeter-street, Strand, W.C. 2. Price 12s. 6d. net.

The Golden Hammer and other Engineering Stories. By A. W. Marshall. London: Percival Marshall and Co., 66, Farringdon-street, E.C. 4. Price 3s. 6d. net.

American Malleable Cast Iron. By H. A. Schwartz. London: The Penton Publishing Company, 2 and 3, Caxton House, Westminster, S.W. 1. Price 35s. net.

The Principles and Practice of Toothed Gear Wheel Cutting. By G. W. Burley. London: Scott, Greenwood and Son, 8, Broadway, Ludgate, E.C. 4. Price 25s. net.

Ships of the Royal Navy. By Oscar Parkes, Editor of "Fighting Ships." London: Sampson Low, Marston Company, Limited, 100, Southwark-street, S.E. Price 6s. net.

Reid's Handy Colliery Guide for Northumberland, Durham, Yorkshire, Cumberland, and Westmorland. Newcastle-on-Tyne: Andrew Reid and Co., Limited. Price 3s. 6d. net.

Imperial Institute Monographs on Mineral Resources with Special Reference to the British Empire: Molybdenum Ores. By R. H. Rastall. London: John Murray, Albemarle-street, W. 1. Price 5s. net.

Manual of Reinforced Concrete. By C. F. Marsh and William Dunn. Fourth edition, revised. London: Constable and Co., Limited, 10, Orange-street, Leicester-square, W.C. 2. Price 21s. net.

The Theory of Emulsions and Emulsification. By William Clayton. Foreword by Professor F. G. Donnau, C.B.E., F.R.S. London: J. and A. Churchill, 7, Great Marlborough-street, W. 1. Price 9s. 6d. net.

The Elementary Principles of Lighting and Photometry. By J. W. T. Walsh, with a preface by Sir J. E. Petavel, K.B.E., F.R.S. London: Methuen and Co., Limited, 36, Essex-street, W.C. 2. Price 10s. 6d. net.

Les Marées et Leur Utilisation Industrielle. Par E. Fichot, Ingénieur-Hydrographe en chef de la Marine. Un volume in-8 couronne de VI–256 pages. Paris: Gauthier-Villars et Cie. 55, Quai des Grands-Augustins 55. Price 9f.

The Work of the Royal Engineers in the European War, 1914–1919: Military Mining. Chatham: Published by the Secretary, the Institution of Royal Engineers. Price 12s. 6d. net.

Year Book of Scientific and Learned Societies, 1922. Compiled from official sources. Thirty-ninth annual issue. London: Charles Griffin and Co., Limited, Exeter-street, Strand, W.C. 2. Price 15s. net.

Text-book on Wireless Telegraphy. Vol. II.: Valves and Valve Apparatus. By Rupert Stanley. Second edition. London: Longmans, Green and Co., 39 Paternoster-row, E.C. 4. Price 15s. net.

Telephone Erection and Maintenance: A Handbook for the Contractor and Wireman. By H. G. White. Third edition. London: S. Rentell and Co., Limited, 36–39, Maiden-lane, Strand, W.C. 2. Price 3s. 6d. net.

Etude sur le Ballon Captif et les Aéronefs Marins. Par le Commandant Charles Lafon, Breveté Aéronaute Militaire Licencié ès Sciences. Paris (6e): Gauthier-Villars and Cie, 55, Quai des Grands-Augustins. Price 20f.

The Journal of the Institute of Metals. Edited by G. Shaw Scott. Name-subject Index to Volumes I-XXV., 1909–1921. London: Published by the Institute of Metals, 36, Victoria-street, S.W. 1. Price 25s. net (postage 9d. extra).

Department of Scientific and Industrial Research. British Association for the Advancement of Science. Fourth Report on Colloid Chemistry and its General and Industrial Applications. London: His Majesty's Stationery Office, Imperial House, Kingsway, W.C. 2. Price 5s. 6d. net.

Les Hélicoptères. Recherches expérimentales sur le fonctionnement le plus général des hélices. Etudes sur la Mécanique de l'Hélicoptère. Par W. Margoulis, Ancien directeur du Laboratoire Eiffel. Paris (6e): Gauthier-Villars and Cie, 55, Quai des Grands-Augustins. Price 10f.

A Six-Cylinder Oil Engine.

A TWO-STROKE oil engine which has just been built by Plenty and Son, Limited, Newbury, for installation in the station of the Farnham Gas and Electric Light Company, is illustrated by the accompanying engravings and in the views on page 176.

One of the chief matters of interest about this engine, which is of 300 brake horse-power, is the fact that it will have to work in parallel with existing Diesel-driven alternators and thus must have similar governing characteristics. It is to be installed in conjunction with a 207-kilowatt alternator, by the English Electric Company, which will give 258 kilovolt-amperes at 0.8 power factor. The current will be three-phase 50 cycles at 2000 volts.

The engine itself is very similar to the marine type, by the same makers, which was described in THE ENGINEER of September 3rd, 1920, but, as will be seen from the illustrations, some modifications have been made. In this connection it should be pointed out that the drawing—

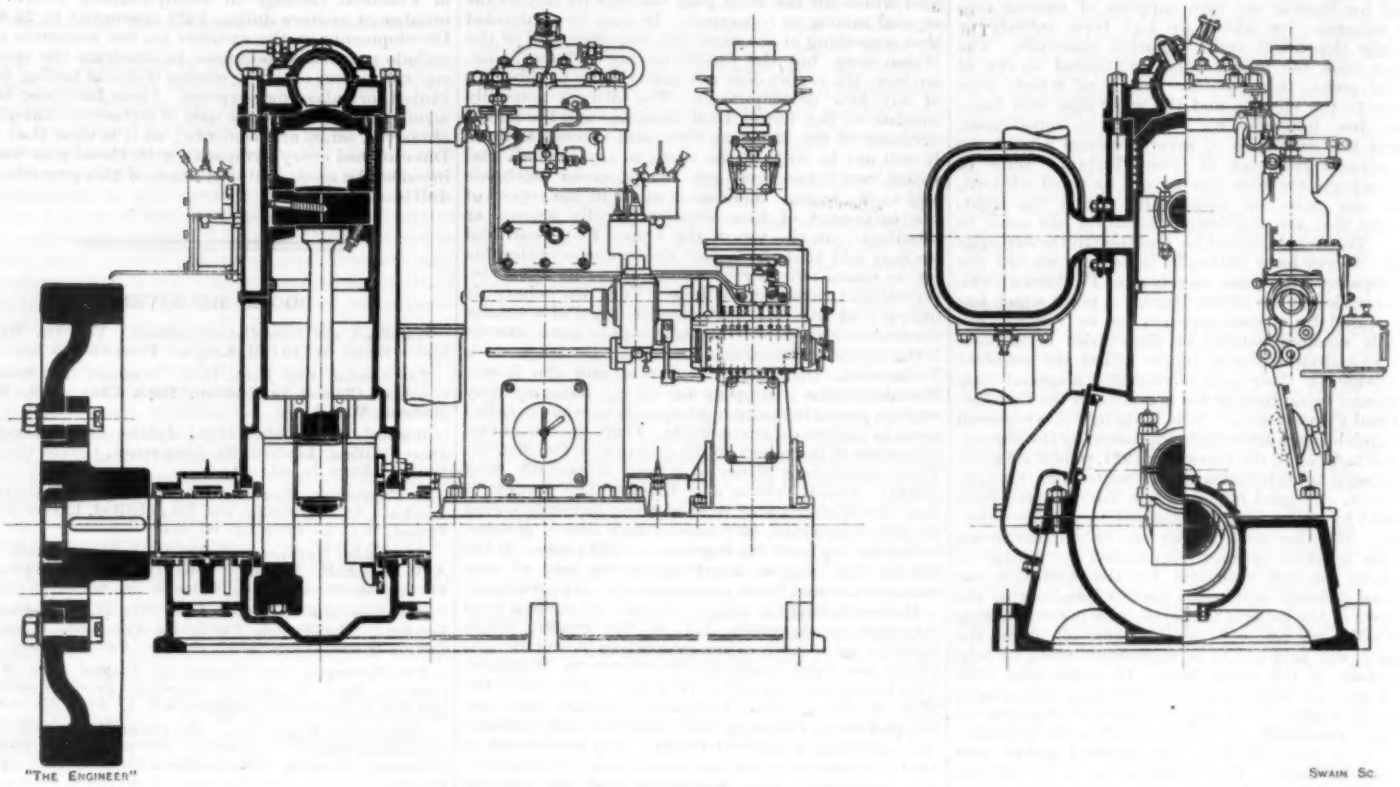

FIG. 1—TWO-CYLINDER HEAVY OIL ENGINE

with four bolts only, and when they are taken off the big ends of the connecting-rods can be got out.

The arrangement of the fuel pumps is quite different from that adopted in the marine sets, in which, it will be remembered, the pumps are all grouped together in the control pillar. In the new land type of engine each pump is arranged as close as is possible to its jet, in order to minimise the effect of elasticity in the oil connections on the timing of the injection. A long cam shaft has therefore been arranged along the front of the engine and drives the fuel pumps fixed on the sides of the cylinders. The mechanism of the fuel pump is shown in Fig. 2, in which A is the cam shaft and B the governor shaft, both of which run on ball bearings. The inlet to the pump is marked C and the outlet D. It will be noticed that the inlet and delivery valves, the latter of which is duplicated, are in one line and can be removed for inspection by taking out one screwed plug. The oil from the inlet passes through a little filter and goes upwards past the suction valve. It then flows downwards through holes drilled in the valve block to the pump barrel, and is returned through the same holes, on the pumping stroke, to pass on through the two discharge valves. The pump plunger is operated by a cam on the shaft through the rocking lever E, which is

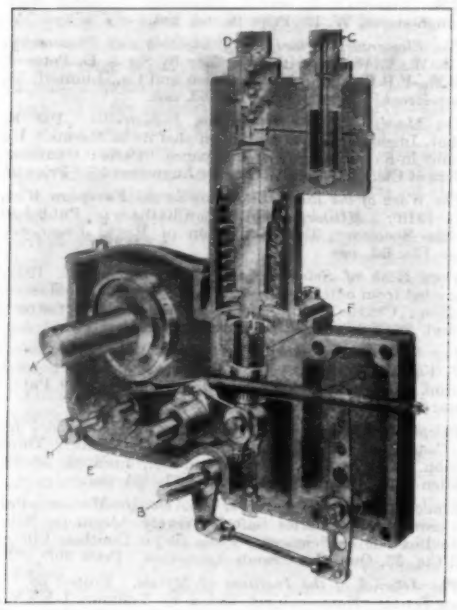

FIG. 2—MECHANISM OF FUEL PUMP

mounted on an excentric pivot and has rollers at each end, while a small spring keeps the rocker in contact with the cam. The stroke of the pump is varied in accordance with the load on the engine by regulating the amount of the motion lost between the rocker and plunger. For this purpose the plunger is equipped with the screwed tappet piece F. The lower part of this tappet has teeth cut round its periphery for meshing with a rack on the plunger G, which is actuated from the governor shaft B by the lever shown. It will be readily grasped that in this way the governor is made to control the stroke of the pump. The whole of the parts are very nicely made, and we understand that it requires a total effort of only 6 lb. at the rack plungers to alter the stroke of all six pumps. Inside the piece F there is a small helical spring which has the effect of retracting the tappet in the event of the governor gear breaking, and thus putting the pump out of action. The excentric pivot of the rocker E is used for putting the pump out of action at starting and stopping, and is operated by the shaft seen just below the cam shaft in the views on page 176.

There is a separate shaft for each group of three cylinders, and they both terminate in hand levers alongside the governor standard. The little lever H—Fig. 2—is used, in conjunction with a tommy bar, for hand priming.

The oil from the fuel pump goes to an isolating valve on the front of the cylinder, of which a view is given in Fig. 4. It is really a two-way ball valve that delivers the oil to either the pilot jet used at starting or to the main running jet in the combustion chamber. The combustion chamber and the arrangements for heating it at starting are the same as those we have already described. Compressed air is used for starting the engine, and is admitted to the three cylinders nearest to the fly-wheel by cams on the main cam shaft. The engine can be started from cold in less than four minutes, and does not need barring.

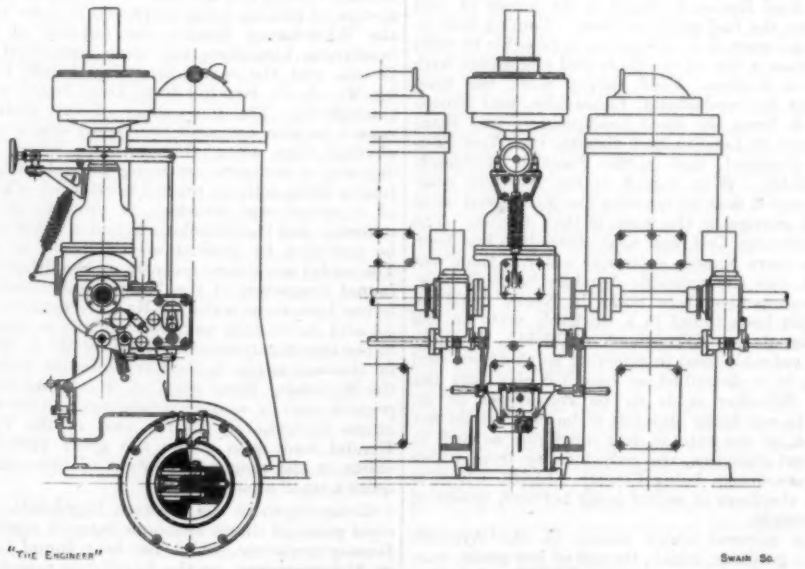

FIG. 3—ARRANGEMENT OF GOVERNOR MECHANISM

Fig. 1—represents a two-cylinder engine, although its proportions are similar to those of the set under review. The bed-plate is naturally deeper than that of the marine type, and water cooling for the bearings is omitted, while the cylinder trunks are cast in one piece with the cylinders. The air inlet valves to the crank cases, which are of the same type as before, with narrow finger-shaped spring steel valves, are placed at the back of the engine. In the front, it will be seen, there are circular inspection doors with quick-acting clamps. The square doors are fixed

The main governor is of the Bee type, manufactured by the Universal Valve and Chemical Accessories Company, Bradford, and is mounted on the column at the middle of the engine. It is fitted with an exterior spring, as shown in Fig. 3, for varying the speed. We studied the governing of the engine very carefully, and found that the speed did not rise momentarily by more than 2 revolutions per minute when half load was suddenly thrown off, and that it returned to the normal of 300 revolutions per minute almost instantly. The emergency governor is also shown in Fig. 3. It is mounted on the end of the crank shaft and operates a lever that is connected with a trip

gear on the central governor standard. This trip gear releases the two hand levers already referred to, and thus throws over the excentric pivots of the fuel pump rockers so that the pumps cease to act.

The lubrication of the main bearings of the crank shaft is effected by means of oil rings. The remainder of the running parts receive their oil from the two mechanical lubricators, which can be seen on the front of the engine. The surplus oil, which finds its way into the bottom of the crank case, is forced out by the compression pressure through the drain valve shown in detail in Fig. 4, and is collected at the end of the engine. The cooling water for the cylinders is discharged through an open spout, so that it may be seen at any time, and, when on the test bed was led to the silencers. The question of exhaust has been rather a serious one in connection with this set, as the pipes will be of considerable length on account of the peculiarities of the station where it is to be installed, and it was equipped on the test bed with a corresponding temporary equipment. The result was very quiet running, and the full output was, nevertheless, obtained. It was running on B.P. Diesel fuel oil, and although the oil obviously contained a considerable amount of solid paraffin, the exhaust gases had a good appearance even immediately after a considerable variation in the load on the engine.

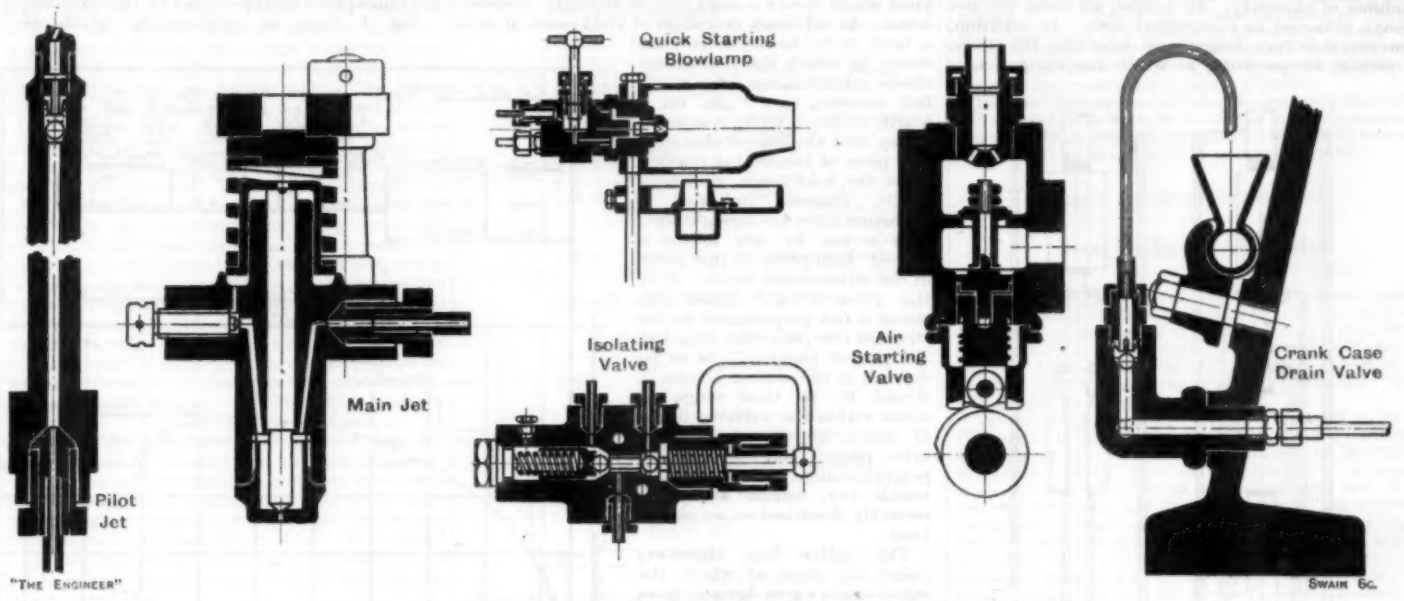

FIG. 4—SECTIONS THROUGH JETS, VALVES AND BLOW-LAMP OF SIX-CYLINDER OIL ENGINE

Separation of Materials by Mechanical Means.

A PAPER on "The Separation of Materials by Mechanical Means" was read on Friday, 12th ult., before the Manchester Association of Engineers by Mr. Cecil Bentham, M.I. Mech. E. The subject was divided into broad headings indicating the nature of the separations which are dependent on the size, shape, specific gravity, texture or magnetic properties. The author devoted the major portion of the paper to the separation of grain, and all the best-known appliances used in the treatment of wheat were described and illustrated. Consideration was given to the effect of (*a*) shaking and (*b*) various combinations of properties. With grain, he said, the separation by size presents problems more involved than the separation of coal, stone, &c. With grain the object is primarily to separate one kind of grain from another, and not essentially to divide according to size. Thus, for example, wheat berries may vary between 0.13in. and 0.3in. long with proportionate girths. The section of the paper on separating by shape was particularly instructive. In separating maize from wheat, for instance, an elongated hole is frequently used, so that wheat can pass through, though the length of the wheat berry may be greater than the diameter of the maize berry. Similarly, the separation of shaley material from coal is effected by plants with corrugated surfaces on the screens, or corrugated rolls which set flat pieces of material on edge, thus allowing them to pass through the holes edgewise, whilst the rounder pieces pass over the top of the corrugations or the top edge of the rolls. The author described the method of extracting small round seeds from wheat by means of a series of cylinders with indentations on the internal cylindrical surface, the indentations being made of various sizes to deal with the different kinds of grain encountered. The principle on which this method operates is shown in Fig. 1.

A more recent development of the same principle is the use of indented discs, revolving in the grain. Fig. 2 is approximately true to size illustration of a section cut through a disc constructed for separating wheat from oats. This section shows the undercut pockets and the manner in which the pockets lift the wheat and reject all longer grains.

Another method in which the shape of the seed is utilised is in the case of mustard seeds, cockle seeds, &c., which are approximately round and are difficult to separate from equal sized pieces of broken wheat. The grain and seeds are allowed to flow down spiral surfaces in very thin streams, and the seeds, rolling more freely than the broken pieces of wheat, travel quicker and are carried by centrifugal force over the outer edge of the spiral, where they fall into a larger collecting spiral trough. Fig. 3 illustrates the action of this appliance.

As an example of apparatus in which combinations of various principles of separation are used, the author cited the flour mill purifier, the function of which is to separate the constituent parts of wheat berries after partial grinding. Sectional views of this appliance are given in Fig. 4. The partially ground stock enters a shaking tray at the left of the diagram Fig. 4 and flows on to the sieve C, which, by virtue of a shaking motion, propels the material along the sieve. This shaking action ensures the stock being loosened during its passage over the tray, the bottom of which is covered with a fine sieve for the first part of the process and a coarser sieve for the latter part of the process. The sieves are usually made of silk, the perforations varying with the kind of stock being dealt with. A current of air is induced from the bottom to the top of the machine by means of fans. The air enters the machine from the atmosphere under the sieves, passes through the sieves and the shaking stock, and travels at a relatively high speed through the restricted space between the trays B. The velocity of the air then falls, allowing the material carried through the spaces to fall back into the trays, with the exception of a small proportion of light dust, which passes away with the air. Towards the delivery end of the machine there is less light material, but a definite stratification of the different-sized particles on the sieves occurs—the light flakey material floats on the top of the heavier. The top layer is the material which the air just fails to lift. There is a tendency in the mass of material being shaken for the heavier particles to sink to the bottom, whilst the lighter particles rise to the top, due to the shake; so some of the material passing over the end of the sieve may be small enough to pass through the mesh, but is prevented by other material and the air current. In this machine, therefore, there are five distinct separations, by combing, shaking, sieving, air currents, and gravity.

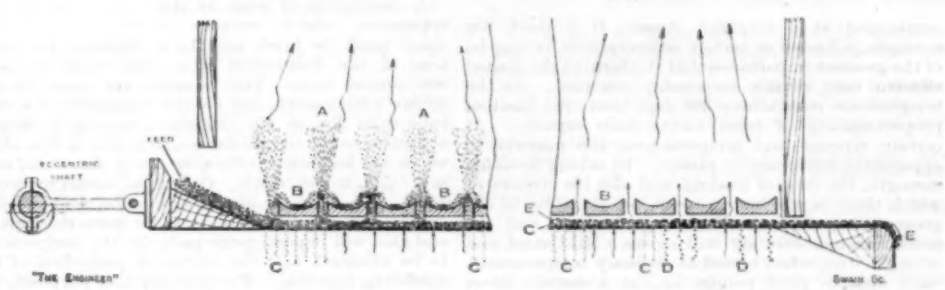
SEPARATIONS
A. DUST TO EXHAUST AND DUST COLLECTOR.
B. LIGHTEST STOCK LIFTED BY AIR CURRENTS AND DEPOSITED ON TRAYS FROM WHICH IT IS AUTOMATICALLY CONVEYED AWAY.
C. GOOD STOCK (GRANULAR) PASSING THROUGH MESHES OF SIEVE.
D. GOOD STOCK (GRANULAR) SLIGHTLY LARGER THAN "C."
E. IMPURE STOCK (FLAKY) ONE NOT LARGER THAN THE GRANULAR STOCK BUT PREVENTED FROM PASSING THROUGH MESHES OF SIEVE BY THE UPWARD AIR CURRENT WHICH FLOATS THIS MATERIAL THE WHOLE LENGTH OF THE SIEVE.
FEED
ECCENTRIC SHAFT
"THE ENGINEER"
SWAIN &c.

FIG. 4—DIAGRAMMATIC SECTION OF FLOUR MILL PURIFIER

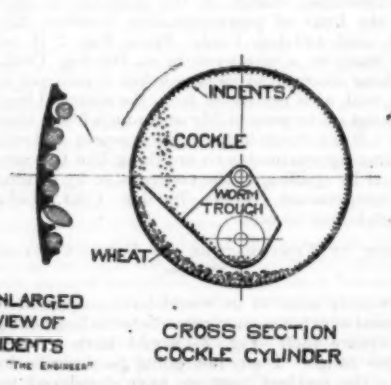

FIG. 1

FIG. 2

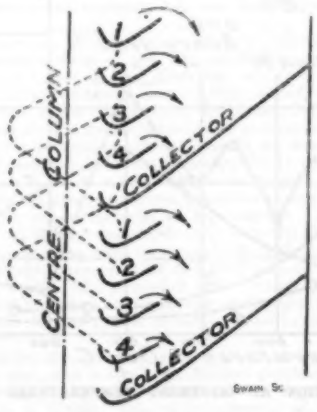

FIG. 3

In the course of his Cantor Lecture on brown coals and lignites, Dr. W. A. Bone said that in the early days of the brown coal briquetting industry in Germany, quite a number of explosions occurred in the factories, and recent years have not been entirely free from them. In the years 1899-1890, Dr. Rudolph Holtzwort and Professor Ernst von Meyer investigated the cause of explosions in the Saxon brown coal briquette factories. They reported (i) that the first and only dangerous agent in a brown coal briquette factory is the fine dry coal dust when it becomes widely disseminated in air; (ii) that the primary cause of an explosion is usually the origination of a local fire of glowing coal dust; and (iii) that such brown coal dust is very liable to undergo smouldering combustion in a slow current of air. It has been repeatedly demonstrated that even a comparatively small ignition of such glowing coal dust when whirled about in air is capable of rapid self-propagation and development into a disastrous explosion, if sufficiently supported by the presence of fine dust spread over large areas subjected to the free access of air.

Tensile Tests of Materials at High Temperatures.*

By Professor F. C. LEA, D.Sc.

THE usual data obtained from a tensile test of a specimen at ordinary temperatures is (1) the ultimate strength; (2) the elongation per cent.; (3) the yield point; (4) the elastic limit, or what would be better called the "limit of proportionalty,"; and (5) the modulus of elasticity. Of course, all these are not always obtained in commercial tests. In addition, however, it is very desirable to determine the stress, at certain temperatures at which the elongation is

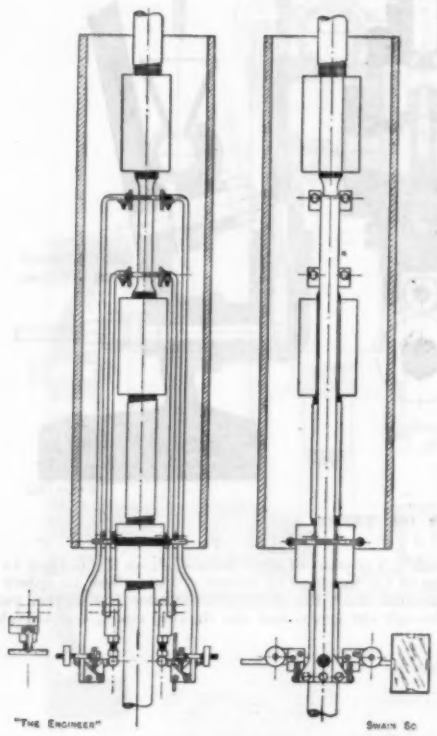

FIG. 1—EXTENSOMETER FOR USE WITH VERTICAL MACHINE

continuous at a constant stress. If a steel, for example, is loaded at certain temperatures, it may be of the greatest importance that the form of the loaded element may remain reasonably constant. As the temperature rises above 300 deg. Cent. the limit of proportionality of most metals falls rapidly. At certain stresses and temperatures, the material is apparently continuously plastic. In taking breaking strength, the time of loading, and also the stresses at which there is continuous creep, are therefore of the greatest importance. With regard to (3) and (4), much misundestanding still exists. Mild steel and wrought iron, when tested at ordinary temperatures, have definite yield points, *i.e.*, at a certain stress elongation takes place quickly, and, as shown by Robertson, elongation continues even when the stress is diminished. This is a true yield point; but in practice the yield point is rather thought of as that stress (*a*) at which there is a distinctly observable strain when measured by a pair of dividers; or (*b*) at which there is a sudden drop of the beam. Neither of these two latter is at all a satisfactory basis of indication for a physical property of the material. Furthermore, on such materials as nearly all brasses, bronzes, and aluminium alloys, as well as in the special aloys of steel, such as the nickel chrome steels, there it no true yield point such as is found in the case of mild steel, and whatever is measured, therefore, according to the methods of (*a*) and (*b*) above are not yield points except in some special sense. It will be seen later that the load-strain curves, or what are generally called "stress-strain curves," for even mild steel, when tested at temperatures, of, say, 300 deg. Cent. or more, indicates a gradual change of form, or else a step by step change, and not the sudden yield which occurs in mild steel at ordinary temperatures. An arbitrary definition of yield point, if such a term is to be used, is that stress, at which the non-elastic elastic extension has some specified amount, say, $^1/_{10}$in. on a length of 2in. Again, it is usual to say that the limit of elasticity of a piece of material is reached when the load-strain, or stress-strain, diagram indicates a departure from the straight line. This is not by any means a correct description of this point in the stress-strain curve. It is the point beyond which the stress is not proportional to the strain in this particular test, but if "perfect elasticity" is to be defined, as the author thinks it should be—as that range of stress within the extreme limits of which no change of form takes place—then the limit of proportionality, as given by a tensile test, cannot always be correctly described as an elastic limit.

The author has, therefore, called the point at which the stress-strain curve deviates from the straight line the limit of proportionality. A very interesting example is given later, showing that at a certain temperature a mild steel specimen can be, for a particular cycle of stress, practically elastic over a total range of stress six times as great as the limit of proportionality indicated in a tensile test.

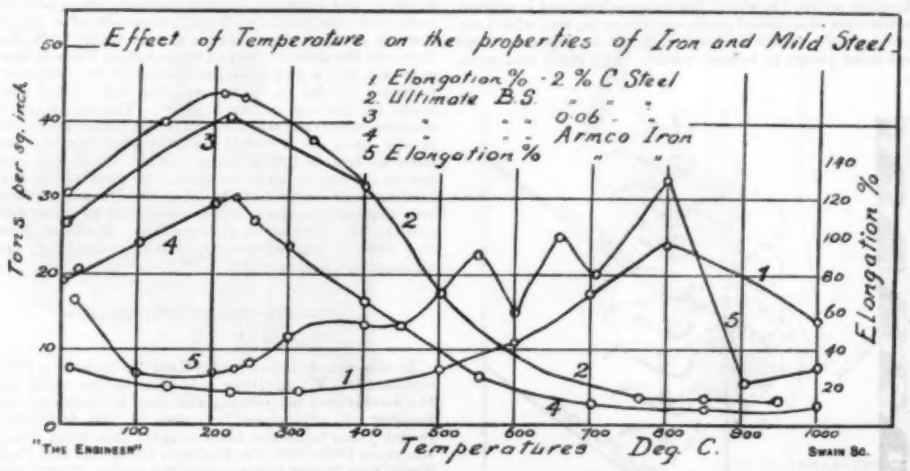
Effect of Temperature on the properties of Iron and Mild Steel
1 Elongation % · 2 % C Steel
2 Ultimate B.S. " " "
3 " " " 0·06 " "
4 " " " Armco Iron
5 Elongation % " " "
Tons per sq. inch
Elongation %
Temperatures Deg. C.
"THE ENGINEER"
SWAIN Sc.

FIG. 2—BREAKING STRESSES AND ELONGATION AT DIFFERENT TEMPERATURES

DESCRIPTION OF SOME OF THE APPARATUS USED.

A description of some of the apparatus, which because of space must be brief, may be of interest to members of the Institution who may wish to carry out similar tests. The furnaces are made in the author's laboratory, and consist essentially of a steel tube from 2in. to 4in. diameter, varying in length, according to the circumstances, from 6in. to 2ft., along which are laid strips of uralite about 1in. wide, and, say, $^1/_{16}$in. to $\frac{1}{4}$in. thick. On this is wound nichrome wire. The diameter of the wire to be used depends on the current that will have to pass through it, and this will depend principally on the temperature to be attained, and the degree of perfection of the insulating material. For ordinary test purposes, the author generally surrounds the coil wound on the uralite by a thin metal cylinder, say, 4in. larger in diameter than the nichrome coil, the space between the two being filled with good quality asbestos fluff or other insulating material. For annealing furnaces, which may have to be kept at one temperature for several days and nights, the outer metal cylinder can be enclosed in an earthenware tube, such as a drain pipe, and an insulating air space left between them. By paying attention to the insulation, a furnace has been kept at 600 deg. Cent., say, for many days on a 220-volt circuit, using a current of less than 1 ampère.

For furnace work in the testing machine, where high currents of from 5 to 15 ampères on a 110-volt circuit must be used if the temperature is to be raised with reasonable rapidity, and where space for getting in the furnace is a consideration, the simple form of furnace is used. For extensometer work, 5 ampères at 220 volts has been found sufficient to raise the temperature with sufficient rapidity. The diameter of the nichrome wire should be such that it will carry at least twice the current given in the makers' catalogues for nichrome that is to be used on resistance frames, where, naturally, the coils will be exposed to the atmosphere and are cooled by the surrounding air.

Fig. 1 shows an extensometer which we have

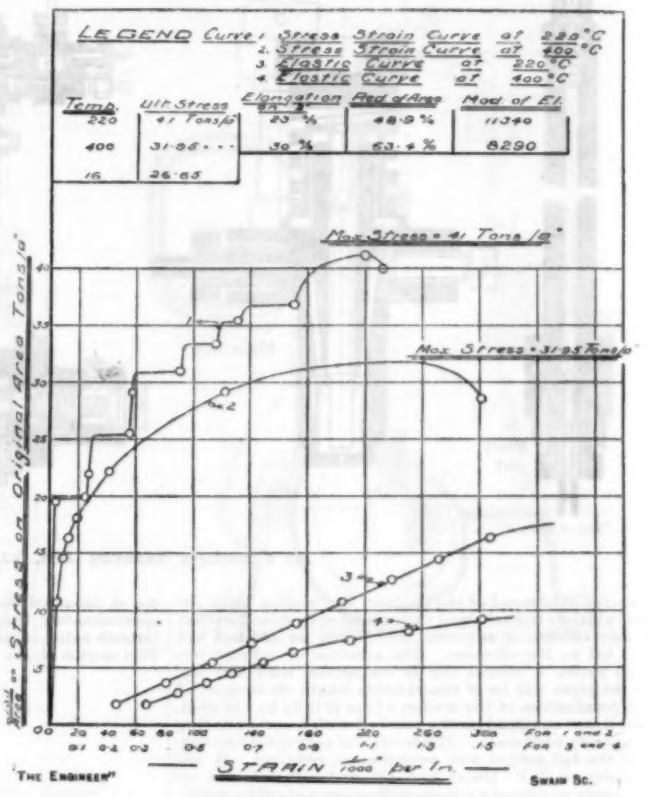
LEGEND Curve 1 Stress Strain Curve at 220°C
2. Stress Strain Curve at 400°C
3 Elastic Curve at 220°C
4 Elastic Curve at 400°C
Temp. Ult Stress Elongation Red of Area Mod of El
220 41 Tons/in² 23 % 48·9 % 11340
400 31·06 " " 30 % 63·4 % 8290
16 26·65
Max Stress = 41 Tons/in²
Max Stress = 31·95 Tons/in²
Yield Point = Stress on Original Area Tons/in²
STRAIN per inch
"THE ENGINEER"
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FIG. 3—STRESS-STRAIN CURVES

recently developed for use in connection with a vertical machine, and which has been made entirely by one of my research students—Mr. H. K. Howarth, B.Sc. Fig. 2 shows results obtained from mild steel containing 0.20 per cent. of carbon, and also for wrought iron, and mild steel containing 0.06 per cent. carbon.

To illustrate the suggestiveness of these tests in relationship to forging temperatures, attention is drawn to the elongation per cent. of armco iron at 675 deg. Cent., 800 deg. Cent. and 900 deg. Cent. These are 100 per cent., 132 per cent., and 21 per cent. respectively. Fig. 3 shows the load-strain curves obtained by means of the extensometer at temperatures of 220 deg. Cent. and 400 deg. Cent. for the mild steel containing 0.06 per cent. carbon. From the table on the figure it will be seen that the breaking stress of the steel at 220 deg. Cent. is 56 per cent. greater than at ordinary temperatures; the elongation per cent. is less at 220 deg. Cent. than at ordinary temperatures—*see* also Fig. 2. That is, the material is harder and stronger. At 400 deg. Cent. the steel is stronger than at 16 deg. Cent., but there has been a considerable change in the modulus of elasticity and the limit of proportionality between 220 deg. Cent. and 440 deg. Cent. From Fig. 2 it will be seen that, at a temperature at 700 deg. Cent., the breaking strength of steel is below 5 tons per square inch, and, as a matter of fact, the material begins to draw out quite perceptibly at a much lower temperature. If the stress in the reinforcement in a concrete building approximates to anything like this amount, then, if by spalling of the concrete, or by conduction, the temperature reaches 700 deg. Cent., failure is almost bound to occur.

EFFECT OF TEMPERATURE ON FATIGUE RANGE OF STRESS.

Probably most of us would have suspected that a material which has an apparent elastic limit of 6½ tons per square inch—Fig. 3—would have a very low fatigue range. I am not going to describe in this paper the method that we have developed to test materials under repetition stresses at high tempera tures, but I think we have overcome all difficulties, and it only remains for us to get at different temperatures results from metals of various kinds. A few results for the 0.06 carbon steel will now be given. Tests in a machine which gives 2000 cycles of direct pulls and pushes per minute gave the results shown in Table I. This is, as far as I know, the first time that such results have been obtained, and they are somewhat surprising, but I think an explanation can be

* From the Honorary Member's Address to the Junior Institution of Engineers, delivered in London on February 9th, 1923.

found. It will be seen that, at a temperature of 400 deg. Cent., the range of repetition stress is six to seven times as great as the limit of proportionality of the steel in tension—see Fig. 3—and is nearly 40 per cent. higher than at ordinary temperatures. Further, it will be seen that, at 400 deg. Cent., the material was run at a total range of stress of 40.8 tons per square inch (± 20.4) for 112,000 repetitions, whereas a specimen put in the machine at 16 deg. Cent., and stressed to ± 20.4 tons per square inch directly, only withstood 6000 reversals of stress.

Other experiments, which there is not space to detail here, have shown, that at ordinary temperatures, slipping of crystals takes place when the range of repetition stress is slightly greater than the fatigue range of ± 13.25 tons per square inch. The stress strain curves Nos. 2 and 4—Fig. 3—for steel at 400 deg. Cent. shows that slipping must have taken place at 6¼ tons per square inch, and that the slipping must have been considerable before 18 tons per square inch was reached. The high temperatire of 400 deg. Cent. must, as the load was gradually applied while the specimen was being cyclically stressed, have produced healing at such a rate that the material not only healed after the first step of the crystals, but also there must have been progressive healing as the repetitions continued, and the material apparently became practically elastic at this temperature for a range of stress of nearly 38 tons per square inch—see Table I.—and, furthermore, that by the process the material was put into such a condition that it would take, when cold, ± 20.4 tons per square inch for 112,000 cycles without fracture.

The author has also been able to show that, by gradually increasing the load and allowing the specimen to run several thousands of cycles at each step of the increasing load, healing can take place after slip at ordinary temperatures, and that the fatigue can thus be raised at least 25 per cent. It is hoped that, by further work on these lines, we shall, at an early date, obtain interesting, and what well may be important, results.

It certainly is an extraordinary result that, at 400 deg. Cent., a piece of steel will stand repetition stresses better than at ordinary temperatures, and even when allowed to go cold, after being subjected to a high range of repetition stress at 400 deg. Cent., the material will withstand a very high stress indeed for a large number of repetitions. It will be very interesting to see what the maximum range of stress in any one direction can be at this temperature of 400 deg. Cent. This work is, unfortunately, very slow, and assistance is limited.

Static Tests of Nickel-Chrome Steels and High Carbon Steels at High Temperatures.

The results of tests on steels of the compositions, shown in Table II. are shown in Table III. and in Figs. 13 to 16; the curves for 0.65 carbon steel and for a nickel-chrome steel—annealed—are shown. It has been stated above that mild steel has its maximum breaking strength at 220 deg. Cent., and the author has previously shown† that in the case of quenched and tempered carbon steels there is little difference between the breaking strength at 16 deg. Cent. and 220 deg. Cent., but that between these temperatures the strength falls, and then slightly rises at 220 deg. Cent., to be followed by a rapid diminution in strength as the temperature is further increased. In the case of certain alloy steels, the ultimate strength at 16 deg. Cent.—Table III.—is greater than at 220 deg. Cent., but at 300 deg. Cent. there is a rise in the breaking strength to nearly that at 16 deg. Cent., followed again by a sudden decrease; there is a tendency to show a mathematical maximum at some temperatures in the neighbourhood of 300 deg. Cent. The temperature of maximum strength of normalised or annealed steels appears to be between 210 deg. Cent. and 300 deg. Cent., depending upon the impurities or the alloying materials. The alloy steels, the compositions of which are shown in Table III., are those frequently used for aeroplane engine cranks and cam shafts, and for rotors of turbines. Steam may possibly be superheated to 400 deg. Cent., and it is, therefore, important to recognise that the modulus of elasticity of these steels may, at this temperature, be less than 9000 tons per square inch, and that limits of proportionality may be very much less than at ordinary temperatures. In turbine discs, the material is not subjected to large variations of stress, but centrifugal and other stresses may be very considerable. Elastic and probable deformations due to stressing beyond the limit of proportionality are clearly, in such machines, of the greatest importance, and these, as well as relative deformations due to temperature differences, become important. It is, of course, hoped in the near future to obtain data upon the effect of repetition stresses at these temperatures. Our tests indicate that none of these materials would be of much use in gas turbines, where temperatures of, say, 750 deg. Cent. might obtain, or in metal gas retorts. It is hoped, however, to carry out tests on high nickel content alloy steels, and on steels containing tungsten, molybdenum, vanadium, &c. Such steels have, even at 200 deg. Cent., statical breaking strengths greater than ordinary cast iron, *i.e.*, when the specimens are broken fairly quickly, but at these high temperatures all metals tend to become above certain stresses plastic, and to show the phenomenon of viscosity, that is, they continue to extend under an applied stress in one direction. The experience with the mild steel at 400 deg, Cent., already referred to, shows, however, that it may be possible to subject metals to rapidly alternating stresses over a total range much higher than the ultimate breaking strength.

† "Proc.," Inst. Civil Engineers, 1919–1920.

Table I.—*Repetition Tests at Varying Temperatures of 0.60 per cent. Carbon Steel.*

	Stress tons per sq. in.	Average temperature.	Cycles.	Remarks.
Specimen 1	±13.00	16.5° C.	6,176,000	Broken
	±13.25		2,740,000	
Specimen 2	±15.61		14,280,000	Unbroken
	±16.09		3,104,000	"
	±16.5	346° C.	408,000	"
	±17.82		2,490,000	"
	±18.25		376,000	"
	±19.35		430,000	Unbroken. Machine stopped and temperature lowered
	±20.4	16.5° C.	112,000	Still unbroken

Table II.—*Composition of "K" Steels.*

	C.	Chr.	Ni.	Mn.
	Per cent.	Per cent.	Per cent.	Per cent.
K1	0.65	—	—	0.80
K2	0.35	1	1¼	—
K3	0.15	0.25	4¼	—
K4	0.35	0.60	3¼	—
K5	0.35	0.60	3¼	—

K1—Hot-rolled medium carbon steel.
K2—Hardened and tempered steel.
K3—Nickel-chrome case-hardening steel.
K4—High tensile steel.
K5—High tensile steel annealed.

Table III.

Specimen.	Ultimate stress. Max. tons per sq. in.	Ultimate stress. Limit of proportionality	Yield.	*Elongation. %	Reduction in area. %	Young's modulus. Tons per sq. in.	Temperature.
K1 (1)	50	31.0	31.7	22.5	43.0	12470	† N
K1 (2)	47.3	29.0	30.1	12.5	23.9	12220	100° C.
K1 (3)	48.3	24.0	26.5	11.0	33.1	11520	200° C.
K1 (4)	56.0	12.0	24.2	11.0	21.5	10420	300° C.
K1 (5)	42.4	10.0	21.5	22.0	72.4	9400	400° C.
K1 (6)	25.6	7.5	17.2	30.0	81.6	6380	500° C.
K3 (1)	48.1	—	26.9	23.0	49.5	12080	N
K4 (1)	65.4	58.4	58.4	16.1	57.1	12900	N
K4 (2)	65.8	—	58.0	16.0	58.8	12940	N
K4 (3)	62.6	47.0	53.4	13.5	53.1	12810	100° C.
K4 (4)	63.1	45.0	52.9	12.0	56.0	13100	200° C.
K4 (5)	65.2	40.0	47.7	7.5	17.57	12940	300° C.
K4 (6)	50.5	26.0	41.0	11.5	49.0	10200	400° C.
K4 (7)	31.8	Creeping	—	20.0	76.5	—	500° C.
K5 (1)	48.5	30.0	31.5	23.0	57.2	13400	N
K5 (2)	44.1	25.0	27.9	22.0	52.9	12800	100° C.
K5 (3)	43.5	24.5	25.1	22.5	60.0	12650	200° C.
K5 (4)	44.55	22.0	24.65	13.5	30.1	11800	250° C.
K5 (5)	49.2	17.0	23.3	13.0	18.5	10250	300° C.
K5 (6)	47.5	15.5	22.4	16.5	32.0	9200	350° C.
K2 (1)	55.0	43.0	44.3	20.0	60.5	13120	N
K2 (2)	51.9	39.0	42.5	16.0	57.3	13010	100° C.
K2 (3)	50.7	36.0	40.0	15.0	55.0	12200	200° C.
K2 (4)	53.0	33.0	38.8	11.6	50.2	11000	300° C.
K2 (5)	47.5	31.0	37.2	14.0	53.6	11200	400° C.

* Measured as $^1/_{500}$in. extension on 2in. † N = Normal.

GREAT WESTERN RAILWAY WORKS.

The decision of the Great Western to spend approximately £1,500,000 in improvement schemes, mainly at the Newport and Bristol centres of the Great Western system, will be welcomed not only as tending to alleviate unemployment in these and other areas, but as providing much-needed additional facilities for the handling of traffic.

The most interesting of the works about to be put in hand is the reconstruction of the Temple Meads goods station, Bristol, at a cost of over £500,000, and the provision of a gravitation shunting yard at the Bristol east depôt. Under the plans which have been sanctioned, the existing goods station will be demolished and replaced by an entirely new and larger station, having an area of about 230,000 square feet, in which provision will be made for eight platforms, each about 580ft. in length. A complete electrical equipment and an improved system of traffic control are other features of the scheme. The gravitation yard at Bristol east depôt is to take the place of the existing marshalling yard on the up side of the line, where, on an average, between 8000 and 9000 wagons are dealt with each week. The provision of a "hump," by which wagons will in future be dealt with on the gravitation principle, will be the means of saving time in marshalling.

The congestion in the Newport area reached an acute stage some time ago, and it has been decided practically to reconstruct Newport High-street Station and to lengthen the platforms up to 1100ft. The re-arrangement of the lines will have the effect of giving four through-line platforms, together with a bay at the Cardiff end of the station on the down side for dealing with the Western Valleys or main line local trains going westwards. In addition to the station footbridge now available there, a wide subway for passengers, with one portion screened off for luggage and parcels, will be made from the station road to the up main platform. The platforms are to be covered for practically the entire length. Provision will be made, with covering, for fish-loading facilities.

The four lines which exist between Cardiff and the west end of Newport Station will be continued on over bridges, and the river Usk viaduct, now undergoing reconstruction, to Maindee Junction, an arrangement which will have the effect of giving communication to and from the direction of Pontypool independently of the Severn Tunnel lines. An interesting feature of the improvements is that by a "scissors" crossing arrangement the lengthened platforms on the main line will be available for two trains of moderate length at the same time.

The Newport High-street goods depôt will also be remodelled and improved. In addition to a new shed, an overhead warehouse will be built, and the latest type of plant for the handling of goods will be included in the equipment. In order that carriages remaining at Newport and requiring to be cleaned may be efficiently dealt with, a new carriage shed, with cleaning appliances, is to be provided at Ebbw Junction, Maesglas, the junction to the recently constructed locomotive depôt.

It is also proposed to carry out the necessary excavation and embankment work to enable the only two remaining lengths of single line in Cornwall, viz., Scorrier to Redruth, and St. Erth to Marazion, to be eventually doubled.

Institute of Metals.

As previously announced, the annual general meeting of the Institute of Metals will be held in the House of the Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1, on Wednesday and Thursday, March 7th and 8th, 1923. On March 7th the annual dinner of the Institute will be held at the Trocadero Restaurant, Piccadilly-circus, W. 1.

The following programme has been arranged:—On the Wednesday at 10 a.m. there will be a general meeting of members in the hall of the Institution of Mechanical Engineers, at which, after the presentation of the reports of the Council on the work of the past year and of the honorary treasurer, and the declaration of the results of the ballots for the Council for 1923, a selection of papers will be presented and discussed. The meeting will be adjourned at 1 p.m. and resumed at 2.30 p.m., and adjourned again at 5 p.m. At 7.30 p.m. for 8 p.m., the annual dinner will be held at the Trocadero Restaurant, Piccadilly-circus, W. 1. On the Thursday the general meeting of members for the discussion of papers in the hall of the Institution of Mechanical Engineers will be continued from 10 a.m. to 1 p.m. and from 2.30 to 5 p.m., when it will be brought to a conclusion. The following communications are expected to be submitted:—

(1) D. Aitchison, "The Mechanical Properties of the Magnesium Alloys."
(2) C. R. Austin and A. J. Murphy, "The Ternary System Copper-Aluminium-Nickel."
(3) S. Beckinsale, "Further Studies in Season-cracking and its Prevention. The Removal of Internal Stress in 60 : 40 Brass."
(4) Colonel N. T. Belaiew, "The Inner Structure of the Crystal Grain as Revealed by Meteorites and Widmanstätten Figures."
(5) Kathleen E. Bingham and Dr. J. L. Haughton, "The Constitution of Some Alloys of Aluminium with Copper and Nickel."
(6) Professor H. C. H. Carpenter, F.R.S., and C. Coldron Smith, "Tests on Work-hardened Aluminium Sheet."
(7) Maurice Cook, "The Recrystallisation of Cold Worked Cadmium."
(8) Marie L. V. Gayler, "The Constitution and Age-hardening of the Ternary Alloys of Aluminium with Magnesium and Copper."
(9) R. Genders, Note, "The Extrusion Defect in Brass Rods Extruded from a Multiple Die."
(10) R. Genders, Note, "The Scleroscope Hardness Test. A New Form of Magnifier Hammer."
(11) Dr. Arthur W. Gray, "Volume Changes Accompanying Solution, Chemical Combination and Crystallisation in Amalgams."
(12) Dr. D. Hanson and Marie L. V. Gayler, "The Heat Treatment and Mechanical Properties of Alloys of Aluminium with Small Percentages of Copper."
(13) Harold Heape, "The Density and the Hardness of the Cast Alloys of Copper with Tin."
(14) Professor F. C. Lea, Dr. V. A. Collins, and Dr. E. A. F. Reeve, "The Modulus of Direct Elasticity of Cold Drawn Metals as a Function of Annealing Temperature."
(15) A. L. Norbury, "The Hardness of Annealed Copper."
(16) A. L. Norbury, "The Hardness of Certain Copper Alpha-Solid Solutions."
(17) N. B. Pilling and R. E. Bedworth, "The Oxidation of Metals at High Temperatures."
(18) A. M. Portevin, "The Structure of Eutectics."
(19) R. C. Reader, "Some Properties of the Copper-Rich Copper-Aluminium Alloys."
(20) Dr. W. Rosenhain, F.R.S., S. L. Archbutt and S. A. E. Wells, "The Production and Heat Treatment of Chill Castings in an Aluminium Alloy ('Y')."

The papers will be taken, as far as possible, in the following order:—March 7th, morning, Nos. 1 and 6 (5, 7, 11); afternoon, Nos. 20, 14, 18 (9, 3). March 8th, morning, Nos. 19, 2, 4 (15, 16); afternoon, Nos. 13, 12 (8, 10, 17). Papers enumerated in brackets may be taken if time permits and in the order given. Owing to the very large number of papers, it is not possible for each to be discussed at the meeting, but correspondence is invited upon all the papers. This should be in the secretary's hands not later than noon on April 9th, 1923.

During the six months ended June 30th last, the assistant Inspecting Officers of the Ministry of Transport held 53 inquiries into accidents to railway servants. Twenty-two related to cases involving the death of 27 men, of whom 20 were permanent way men. No less than 9 of the last were killed as a result of failure to act up to rule 273 (a), which provides that when a train is approaching the men must stand clear of all lines.

Vane Wheel Propulsion.*

By MAURICE E. DENNY, B.Sc.

A VANE wheel is composed of two or more helical surfaces or vanes attached to arms having the desired helical pitch, the axis of revolution being substantially fore and aft, and the diameter such that only the vanes are immersed in the water when propelling a ship. The axis of rotation is therefore well above the water.

In vane wheel design we have the valuable property that the axis is above water and can be carried on the main body of the ship with a long counter clear of the water, thus at once obtaining a favourable location for reducing "augmentation" to a minimum, and dispensing with the necessity for underwater shaft supports, with all they mean in increased resistance. In comparatively shallow-draught vessels where there is variation of draught, vane wheels provide an automatic adjustment of immersed area to thrust with no accompanying loss of efficiency. And, lastly, there is an incidental advantage which is of great value in shallow-draught vessels with vane wheels. When driven at full speed, the stern of a vessel falls relatively to the surrounding water; at the same time the water rises in a long wave immediately behind the vessel, the crest of this wave generally coming about the position of the vane wheels. Both of these add to the immersed area of the wheels; in fact, the effect of a "tunnel" is obtained without the drawbacks which are usually associated with tunnel steamers' design.

There is, however, another quality which vane wheels possess in greater degree than any other form of propeller: they offer exceptional manœuvring power, direct from the main engines. It will be obvious that with a partially immersed propeller there must be a large reaction in the transverse, or athwartship direction. Consequently, vane wheels must be fitted as twins, so that the reactions may balance one another when it is desired to go straight ahead or astern. It follows that when one of these twin vane wheels is kept going "ahead," and the other is made to go "astern," a powerful double reaction is produced in the transverse direction, which causes the vessel to turn with great rapidity. Vane wheels should be fitted to turn outwards on top, as is usual with twin-screw vessels, and then to the above reaction is added the ordinary turning moment due to the leverage of the thrusts about the centre line of the ship. It will be realised that, when starting from rest, with the vane wheels thrusting equally in opposite directions (one vane wheel thrusting "ahead," and one thrusting "astern"), the ship can make little progression in either direction, but turns approximately in her own length under the action of the forces indicated above.

Other features are a great saving in machinery weight as compared with paddle engines, due to the higher revolutions, and easy accessibility to all parts without the necessity for docking as compared with screws.

EFFICIENCY.

From the information at present available it appears that vane wheel propulsion gives a higher efficiency than any other known method. The only systems which require survey in this connection are the submerged screw propeller, the side padde wheel, and the stern wheel.

Very high efficiencies may be obtained with a large single-screw vessel of deep draught, having a large single propeller and no shaft supports, but even this may be excelled by vane wheels. For the present, consideration may be confined to vessels of moderate or shallow draught, such as are used in river or estuary service, though there is no *a priori* reason to suppose that vane wheels would not do equally well at sea on ships where the draught variation is not extreme.

Taking twin-screw steamers as used for river work, it is generally found that there is too little draught for adequate propeller diameter, that the propellers draw air, or from a combination of causes give a poor propulsive efficiency, one cause being low "hull efficiency."

As the result of experiments in the experimental tank and on a full size ship in the Gareloch, it was found that by using vane wheels a reduction of power of about 40 per cent. was obtained for the same speed and displacement on such a type of vessel. The particulars of the vessel and results obtained are as follows:—

Length, in feet		100ft.
Breadth, in feet		23.5ft.
Draught, in feet		4ft. 5½in. F. 4ft. 8in. A. 4ft. 8¼in. mean
Displacement, in tons		186
Speed, in knots		9
	Screw propellers.	Vane wheels.
Diameter, in feet	4ft.	11ft.
Pitch, in feet	5ft. 8in.	16ft.
No. of blades	3	3
Total projected area of blades	10.2 sq. ft.	—
Immersion of tips in still water	$3^{7}/_{16}$in.	—
Revolutions per minute	226	66
Total sectional area of water acted upon when at full speed	25.14 sq. ft.	59.26 sq. ft.
E.H.P. of naked hull	77.5	77.5
Shaft H.P.	197	116
Efficiency, i.e., E.H.P. / S.H.P.	39.4	67.0

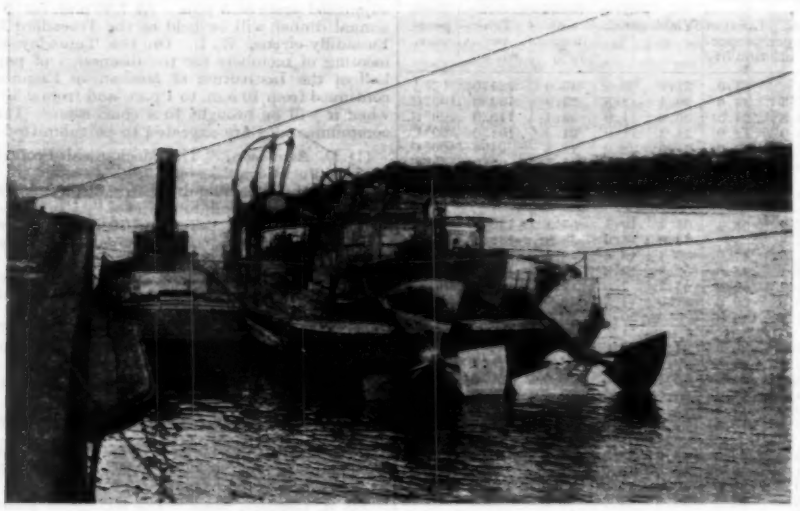
N.B.—It should be noted meantime that the vane wheels were driven by oil engines through leather belting, and that a combination of circumstances rendered it difficult exactly to determine the shaft horse-power. The figure noted was derived after cross-checking from several points of view, but further experiments are in progress in order that the shaft horse-power may be established, as far as possible, beyond doubt.

It may be objected that the figures given above are unduly favourable to vane wheel propulsion, in that the twin-screw vessel which forms the basis of the comparison has a propulsive efficiency which is unduly low. It is admitted that the efficiency is low; but, on the other hand, it should be noted that the requirement of a considerable speed, in association with a limited draught, compels the installation of the largest possible size of propellers, which inevitably means that the tips are too close to the water, and that the propellers themselves are unduly shrouded by the hull. It would be possible to produce a better efficiency if the speed requirements were not so high; but as this vessel represents a class which is common in shallow waters in various parts of the world, and which runs to the entire satisfaction of the owners, it seems clear that the efficiency is not one which can be considered unduly low from the commercial point of view.

Experimental model trials made to compare side paddle wheels with vane wheels showed a gain for the latter of about 30 per cent., while a similar set of trials with a stern wheel steamer indicated a gain of 20 per cent. These figures, however, still await confirmation in full size trials.

It must be pointed out that all these experiments were carried out at the same draught and displacement for both vane wheels and other propellers as a direct comparison, but in practice there would be other gains.

The limiting factor for minimum size of vane wheels for best results seems to be pressure per unit area of immersion, in relation to speed of advance. It should not be forgotten that vane wheels share with paddles the disadvantage of being surface-breaking instruments. The losses at entry and exit of the vanes, however, are not comparable with those inherent in paddle floats, but both instruments seem to give signs of a breakdown when overloaded. In other words, as soon as the pressure per unit of area becomes too great and the slip consequently excessive, a marked falling off in efficiency is sustained. The cause of this is somewhat obscure, but may be connected with turbulence and air drawing. Special tests are being carried out in the experimental vessel to determine these limits, and from these it is expected to ascertain what maximum pressures may be carried at different speeds without excessive loss in efficiency. In the meantime it is desirable to provide ample diameter where possible, so as to maintain the high propulsive efficiency associated with a moderate slip.



SHALLOW DRAUGHT STEAMER FITTED WITH VANE WHEELS

* From a paper read before the Institution of Engineers and Shipbuilders in Scotland on February 13th.

A CONFERENCE was lately held at Berne between the Swiss Federal Railways and the Swiss locomotive factories, when the question of new orders for twenty electric locomotives was discussed. The management of the Swiss Federal Railways demands a reduction in price of 100,000 francs on each locomotive, i.e., about 25 per cent. of the last price.

Gliders and their Value to Aeronautical Progress.*

By COL. A. OGILVIE.

There would appear to be very little likelihood that engineless aeroplanes can ever be of practical service in journeying from place to place or even that they will be much used for sport. The necessity of an up-current of some kind to support the machine renders the first almost impossible, and confines the second to special localities. The sport of motor cycling would be a tame affair if it were limited to hill climbing up special hills.

There are possibilities in the use of gliders for purposes of training pilots, and there are certainly possibilities in the development of small sporting machines of 15 to 20 horse-power capable of horizontal flight, with 5 horse-power, and doing 100 miles or so to the gallon, but the real immediate value of gliders lies, as it always has done, in the opportunity they afford of technical experiment in a simple and inexpensive manner.

In experiments with engine-driven aeroplanes, the horse-power of the engine and the efficiency of the propeller are always difficult to estimate exactly. The detail design has to be carried out with care and attention in order to keep the percentage weight of the structure within fairly close limits, while the cost of the experimental work is almost prohibitive to private firms. On the other hand, with gliders the motive power, which is the force of gravity, is perfectly definite in amount and always reliable, and for many purposes the machine can be built in a simple, rough and ready manner as long as the external form is correct.

There are two main technical problems in the design of the commercial aeroplane of the day, and it is suggested that solutions of either or of both are more likely to be found by means of experimental work with gliders than by other means.

The first is the increasing of aero-dynamic efficiency, to enable considerably greater loads to be carried for the same power or the same load for less power. The overall efficiency, the ratio of lift to drag, or, in other words, the inverse of the gliding angle of the commercial aeroplane of the day is about 8 to 1, in some cases even less. To put the result in another way, about 60 horse-power is required to carry each individual passenger for the usual three-hour journey at a speed which is necessary to combat the normal wind conditions. This is obviously a very high figure, and gives an indication of the reason for the high cost of aerial transport. It should be noted that in addition to the heavy fuel costs entailed by this poor efficiency, there are heavy capital and insurance costs, all of which would come down if the overall efficiency could be increased, as it is perfectly certain it could be provided that an adequate amount of experimental work can be done.

The second problem for solution is the improvement of controllability at low-flying speeds, so that in the event of an engine stoppage, the aeroplane can be landed in awkward fields with greater safety than at present. It is well known to aeronautical engineers that an aeroplane, the stalling speed of which has been tested to be, say, 50 miles per hour in good weather on a large aerodrome, is never, in the event of a forced landing, glided in at a speed of less than 60 miles per hour. This additional 20 per cent. over the stalling speed adds greatly to the difficulties of the landing and to the shock in the case of an accident, and would be entirely unnecessary if the pilot had an aeroplane over which even in gusty weather he had complete control right down to the stalling speed. This difficulty is such a commonplace among pilots that it does not occur to them to worry about it, but it is a problem to which a great deal of attention is being paid, and to an attack on which the Aeronautical Research Committee is devoting a considerable amount of the resources at its disposal. The recent gliding competition at Itford Hill showed how much room there was for improvement in the controllability of the machines entered, and instilled a belief that other competitions would cheaply and quickly effect such improvement.

There can be little doubt that these are only two instances out of many in which we have good reason to expect substantial progress in aeronautics by means of experimental work with gliders.

* Paper read at the Third Air Conference, February 6th.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Pig Iron Scarce and Dear.

THE complication in the Ruhr continues to be the disturbing factor in the pig iron trade. Midland smelters have practically no iron to sell and there is little prospect of output increasing. The position, according to furnacemen, is that, owing to the situation on the Continent, coke in particular is being exported in such phenomenal quantities to foreign markets that our own basic industries are suffering for want of fuel and from the prohibitive price to which it is rapidly rising on account of the new and, it is suggested, purely spasmodic demand, which will fall away as quickly as it arose once the trouble is settled. However, at the moment there is a veritable famine in coke. Some of the furnaces are in trouble over supplies, the irregularity of delivery interfering with output. In this district the dearth of coke is an effectual barrier to enterprise. Several local furnaces are ready for re-starting, and have encouraging inquiries, sufficient to secure the disposal of the production. But the necessary fuel cannot be got, and as the purchases for abroad are increasing, the prospects, from the furnace point of view, are anything but cheerful with regard to future supplies. Ironmasters hereabouts feel very sore over the matter, and the Wolverhampton Chamber of Commerce is urging the Government to take action. With coke prices advancing against them,

smelters have this week increased their quotations. Many of them were in the nature of a protective barrage. Northamptonshire foundry material is being quoted at £4 15s., with Derbyshire 2s. 6d. higher. These, however, are practically nominal figures, as it is difficult to get orders accepted. The furnaces are not eager for future business in the present state of uncertainty. Buyers, as a rule, do not pretend to keep pace with the advance in prices. A few may be forced to concede exceptional rates to extricate themselves from difficulties, but the transactions now passing are of no great moment. The demand has, nevertheless, improved in all directions, engineering firms, equally with makers of iron and steel, being keen for supplies. The Staffordshire ironworks are taking more pig iron than has been the case for a considerable time. Inquiries from abroad continue to be received, and a good deal of American business cannot possibly be handled by Northern or Midland furnaces.

Staffordshire Iron Trade Improving.

The Staffordshire finished iron trade is showing decided improvement. There is an altogether better demand, which in propitious circumstances would doubtless solidify into a stable basis for trade expansion. Orders come in fairly freely, though there is no rush, and the continental disturbance does not make for the development of export business. The tonnages ordered on home account are on the increase, a feature very noticeable with regard to parcels sent to country warehouses. The small drop of 2½ per cent. in ironworkers' wages has had no effect on the market. Prices remain much as last week. Marked bars are firm on the basis of £13 10s. Makers of unmarked bars of Crown quality find their position a little strengthened, and in some cases they are approaching the £11 10s. standard lately fixed by Lancashire and Yorkshire makers. The market level for this material, however, is round about £11. Nut and bolt manufacturers are getting rather more orders than were forthcoming a few months ago. Staffordshire mills who supply these concerns quote £10 10s. for nut and bolt iron, but in some cases rather more is asked. Lancashire makers require £10 15s. delivered Darlaston. They have good outlets for their production abroad and can afford to be independent. Belgian shippers are again quoting; their price this week being £8 15s. delivered. The difference is offset, however, by the uncertainty of delivery. Some consumers who have contracts running with Belgium do not find they are getting supplies at all regularly. Importing merchants could have numerous orders for Belgian No. 3 iron if they could guarantee early delivery. An offer received within the past few days, however, named ten to twelve weeks as the possible period of delivery. This is of very little use to nut and bolt manufacturers who want the iron. They are accordingly placing their business with Staffordshire mills. Fencing iron at date ranges from £10 10s. to £10 17s. 6d., the latter being the figure quoted by Lancashire makers. Gas tube strip continues to command from £10 15s. to £11.

Galvanised Sheet Prices.

The galvanised sheet trade continues well employed, and demand is such that again this week makers have been able to command advanced prices for their products. Last week there were mills which accepted £18 10s. for 24-gauge corrugated sheets. This week the minimum quotation would appear to be £18 15s., with some firms demanding £19. The black sheet mills continue busy, receiving increased orders, particularly from the motor industry.

Rising Values of Steel.

The stimulus derived from the dislocation of the steel trade on the Continent, following the French occupation, is continued, and prices both in the finished and semi-finished branches have this week been further advanced. Small steel bars now range from £9 15s. to £10, and bedstead angles, though it is calculated they cost 5s. more to roll, are on very much the same level. Angles and joists have been further advanced 5s. per ton, making the price at date £9 15s., while tees now rule at £10 15s. There has been no concerted movement by the makers of steel hoops, but prices well above the declared basis of £11 10s. have been quoted. The rapid rise in steel values has enabled merchants, well bought, to undersell by several shillings per ton the steel works themselves. The works are understood to be well off for orders, but there is a good deal of uneasiness as to the effect of these price increases. Semi-finished steel is now difficult to obtain, and material which was £8 to £8 5s. last week is to-day being quoted by certain well-known firms up to £8 15s. The minimum figure now appears to be £8 5s. There is practically no continental crude steel available, and consumers are accordingly obliged to rely upon the home steel works. It is understood that production is steadily decreasing both in France and Belgium as the result of the Ruhr occupation, while increasing quantities of fuel are bought from this country.

Wire Prices.

The wire mills are kept well employed, most of them having several months' work in hand. Business has been stimulated by the expectation of higher prices, but while the lowest quotation for wire rods in this district is £10 5s., which is slightly dearer than some little time ago, it is not considered sufficient so far to warrant an increase in the price of finished wire. Prices accordingly are unaltered.

Fuel Supplies.

The question of fuel supplies has during the week loomed large in the minds of manufacturers in this part of the country. All classes of fuel are getting scarce, deliveries are delayed, and prices are steadily rising. Moreover, it is felt that the shortage will be intensified by the large demands from the Continent. Coke supplies in particular are of vital importance to Birmingham and the Black Country, and industrialists here, pig iron producers in particular, are very concerned over the considerable shipments of this material to export markets. So much so that the Wolverhampton Chamber of Commerce has decided, in view of the effect on the production of iron and steel in this district, to call the attention of the Government to the matter. Continental buyers are paying fancy prices, and consumers in the Birmingham district, as a result, have to pay 25s. at ovens for furnace coke or go without. A firm of smelters anxious to re-start its furnaces was this week informed by a large manufacturer of coke that a well-known ironmaking concern had offered £1 8s. 6d. at the ovens for all the coke that could be supplied. With coke at this price and difficult to obtain even at that there seems little prospect of those blast-furnaces in the Midlands which are ready to re-start being put into operation, though it is understood that their prospective output could be swallowed up by the industries awaiting it.

Output at Cannock Chase Pits.

The Cannock Chase coal trade has improved considerably of late and most of the pits are now working full time. The output of the coal for some of the pits has reached record figures. The miners of Cannock Chase are paying increased attention to output, and the official figures issued by the Mines Department of the Board of Trade clearly prove that the local miners' output is a good deal higher per shift than the average for the whole of the coalfields in the United Kingdom.

Railway Improvements in Staffordshire.

Satisfaction is expressed that the Staffordshire district is to derive benefit as the result of the decision of the directors of the Great Western Railway to carry out important improvement schemes in pursuance of its policy to facilitate traffic working in congested areas and to afford relief to the unemployed. In the Staffordshire district a new locomotive depôt is to be provided at Stourbridge, at a cost of about £120,000, and extensive improvements involving the provision of electric lifting appliances are to be carried out at the Walsall-street goods depôt, Wolverhampton, at a cost of £20,000.

Wolverhampton Corporation Schemes.

The Sewerage Committee of the Wolverhampton Corporation is proposing to construct two storm water tanks having a combined capacity of 650,000 gallons, at the Corporation sewage outfall works, at an estimated total cost of £9000, subject to the necessary sanction of the Ministry of Health to a loan to cover the cost of the scheme. The Water Committee is recommending the sinking of two permanent bore-holes in connection with the new waterworks to be constructed at Dimmingsdale, at a cost of £11,000.

The Unemployment Barometer.

The unemployment barometer in the West Midlands continues to fall, and again this week there is a very satisfactory reduction in the number of persons out of work. There has been a decrease on the week of 3115 and on the past fortnight of 7564. In the Birmingham area there are 968 less people out of work than was the case a week ago, at Coventry 227 less, and at Wolverhampton between 200 and 300 less.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

General Conditions.

THERE has not been very much change in the general condition of the iron and metal markets since I last wrote, but the feeling is steady, and although some people think that the advance has gone far enough, and that any attempt to push prices up further might lead to a collapse, there seems to be still a good deal of strength in the markets. It may be admitted that in some sections buyers are unwilling to pay the higher prices and actual business has shrunk a little; but this is mainly in those cases where ample provision for supplies was made before the market began to advance. The question is whether the present level of prices will permanently check trade; and, of course, another important question, especially in the iron and steel section, is whether the prices will stimulate production to too great an extent. This would certainly be the case in the matter of pig iron were it not that the difficulty of securing supplies of fuel is causing owners of the idle blast-furnaces to hesitate about the safety of re-lighting them until they are sure of their coke.

Metals.

The feeling in the copper market seems to be fairly cheerful this week, but unless it is based upon reports of larger consumption in America one cannot quite understand the optimism. Certainly European consumption—apart from that in Great Britain—is in a very bad way, and recovery of trade in Europe seems to be as far off as ever. It is, of course, possible that France will succeed in reorganising the trade in the German "Black Country," and in any case some of the trade which is threatened with destruction there will probably come to Great Britain and America; but this will not compensate altogether for the loss of consumptive power which results from the disorganisation of a great industrial district. The copper market here has been strengthened by reports that American consumers are freely buying electrolytic copper at 15 cents per pound. At the present rate of exchange this is rather higher than the price obtainable in Great Britain, and if the buying is continued it may lead to a further rise in electrolytic on this side. There is, however, another report from America which would seem to indicate that aluminium, after years of threatening, is at last asserting its claim to compete with copper in the electric cable business. It has, of course, long been known that electric cables could be made more economically with aluminium for a conductor; this was claimed when aluminium was about twice the price of copper. Now the metal is being made in Canada to sell at very nearly the same price as electrolytic copper, so that the whole advantage in specific gravity is gained, provided, of course, that no other disadvantage is discovered. The home trade prices for manufactured copper and brass have not been altered, and the various anomalies already pointed out remain to irritate the British consumer. The market for tin has been fairly steady, and with a slight tendency towards rather higher prices; but apparently the feeling in the market is that tin is high enough. There has been a very good demand lately from the tin-plate industry, but, of course, the demand from the Continent is very poor. The market for lead is steady and firm, but no further appreciation has taken place. There seems to be no probability of any increase in the supply here. The output of Mexican lead is increasing, but it will be absorbed in all likelihood by the United States, where the prices are attractive. Spelter remains fairly steady round about £35 for prompt metal. The galvanisers are buying fairly freely, but there is as yet no large demand from the brass trade. The backwardation on forward spelter is now only moderate, being about 10s. per ton for delivery up to April.

Pig Iron.

The market here for pig iron of all classes is firmer, and there is a further tendency to put up the prices. So far as foundry iron is concerned, however, consumers are not at all disposed to follow the market, and many of them have withdrawn for the present, so that the volume of business being done is much less than it was. Sellers here, however, are encouraged to stand out for higher prices by the reports of scarcity and quite extravagant figures in the Cleveland district. It is said that up to 112s. 6d. per ton has been paid in Cleveland for small lots of No. 3, and this induces sellers of Midland iron to try for more money here. Some of them are talking now of 95s. per ton at the furnaces, which would mean about 105s. delivered in Manchester if bought through a merchant. Nevertheless, it is still possible to buy No. 3 Midland iron at 100s. delivered. The further advance in the steel-making irons has brought the price of hematite, delivered in Manchester, to rather more than that of Scotch No. 3; so that the ironfounders here who were trying to use hematite in place of Scotch may now just as well go back to their old mixtures. It is, however, still true that the sales of Scotch iron in this district are much less than they used to be.

Finished Material.

The demand for manufactured iron and steel is still fairly good here, although the reports from other districts suggest that the recent advances in price have tended to check new business. It is, however, true that much more inquiry is now coming in from India, Japan and the Far East; this being diverted from continental makers by the difficulty of arranging business with the Continent. Some Midland makers are now quoting £10 to £10 10s. for bar steel, and £9 10s. for sections, but probably both plates and bars can still be bought at the former prices.

Scrap.

The market for scrap is decidedly firmer. There is still too much cast scrap about, but one does not find the dealers so weak as they were, and the fact is that the Yorkshire buyers are offering better prices than can be obtained in Manchester. With common pig iron over 100s., it is, of course, absurd to go on selling machinery scrap at 85s. Both wrought scrap and steel scrap are now scarce, and the prices here are rather uncertain. Probably 85s. to 87s. 6d. per ton could now be obtained for heavy wrought scrap delivered.

Proposed Amalgamation of Trades Unions.

A conference was held in Manchester last week at which a resolution in favour of the amalgamation of the thirty-five trades unions connected with the metal trades was adopted. Twenty-nine unions were represented, including the Amalgamated Engineering Union, the National Union of Foundry Workers, and the Electrical Trade Union. It was decided to appoint a Committee to investigate the possibilities of amalgamation to report to a further conference. The unions concerned have a total membership of about 800,000.

Manchester Association of Engineers.

Thanks to the hospitality of the President, Mr. Daniel Adamson, the members of the Manchester Association of Engineers and their ladies enjoyed a delightful evening on Friday last at a conversazione held at the City Art Gallery. The attendance numbered over 400. After being received by the President and Mrs. Adamson, the guests were free to roam at will through the various rooms and inspect the City's art treasures or listen to an admirable vocal and instrumental concert. Altogether the function was a great success.

Proposed Engineering Works at Fallowfield.

In spite of the opposition on the part of residents in the vicinity of the site on which Henry Simon, Limited, propose to erect their new works within the city boundary and the firm's willingness to withdraw to another site outside the municipal area if desired, the Corporation, being anxious to encourage industries, does not intend to allow minor differences to interfere with projects such as this, and it seems highly probable that the original site will be secured. Messrs. Simon have given an undertaking to erect a factory free from objectionable features such as a foundry, and all the power will be taken from the Corporation electricity works. It is likely, too, that they will provide housing accommodation for their workpeople.

Runcorn and the Ship Canal.

At a meeting of the Runcorn Urban District Council held last week it was decided to forego the right to a dry dock as provided for in the original agreement with the Manchester Ship Canal Company. Instead, the Council has accepted the offer of the latter company of land necessary for making a new road from the Transporter Bridge to the outskirts of the town to obviate the

passage of traffic through the narrow thoroughfares. The Ship Canal Company has also offered to construct a wet dock and retain its repair shops at Runcorn.

BARROW-IN-FURNESS, Thursday.

Hematite.

The hematite pig iron trade continues to develop, and there are numerous orders, including an increasing number from the Continent. Those who hesitated to agree with the fact that the Ruhr occupation was affecting the trade are only too ready to fall in with the opinion now. The increased demand has had the effect of sending up the price of pig iron, as was mentioned in this report previously, and there is on the part of some a keenness to buy. At the same time the market is in a rather peculiar condition. The heavy buying has given a fillip to trade, but one wonders if the improvement is likely to be lasting. With America in the market again, trade would appear to be well on the way to a miniature boom, but makers are very wary, and in a way of speaking are keeping a tight hold on the reins. They are not going to let the horse run away with them, and that is why, despite the very heavy demands on the present restricted output of the ironworks, there is no great hurry to put in new furnaces. If the makers believed that the improvement was to be lasting there would be no hesitation about re-starting furnaces. Several are ready to begin, but caution still prevails. Apart from ordinary mixed numbers, there is a much better trade in special qualities and the price has risen as in the case of ordinary sorts. There have been shipments of pig iron for Philadelphia, Scotland and North Wales during the week.

Iron Ore.

The iron ore trade continues to improve, and the business in ore reflects the increase. Several of the mines are at normal output. Foreign ore is arriving in larger quantities, and there were two cargoes into Barrow last week. Stocks at the docks are now reduced.

Steel.

The steel trade does not show up as well as the iron trade, although as far as Barrow is concerned there is work for the rail mill for a couple of months or more. At Workington there does not seem to be the same prospect at the moment. The foundries are experiencing a little better trade, while the hoop and small bar mills at Barrow are still enjoying a certain amount of activity.

SHEFFIELD.

(From our own Correspondent.)

Busy Steel Works.

ACTIVITY in the local pig iron trade and the heavy steel branches is not only well maintained, but goes on increasing. The shortage of pig iron has almost reached the famine stage, while there is a full demand for all the basic billets that are being turned out, and acid steel is also in very good request. Prices of pig iron and basic steel have gone up during the past week or two, and there is a probability of a further advance in acid qualities. The Sheffield furnaces are well employed, although in the Rotherham district there is still a number standing idle. No semi-manufactured steel is being stocked, but all of it is going straight into consumption. The rolling mills are working better than at any time last year, although they are not yet fully employed. Large quantities of steel are also going into the forges. Among the local works which are busy in all departments are those of the United Steel Companies—namely, Steel, Peech and Tozer; Samuel Fox and Co.; the United Strip and Bar Mills; and the Frodingham Iron Company. Several other large establishments—including Parkgate, Vickers, Cammells, Kayser Ellisons, Jessops, Brown Bayleys, and Bessemers—are also well supplied with work.

The Lighter Branches.

The chaotic condition of affairs in Germany seem to have benefited the heavy trades by reducing competition, but in other respects the confidence of buyers appears to have been upset, and the feeling in the lighter steel and tool branches is less sanguine than it was a month ago. While some firms are working three or four days a week, others are scarcely able to report any benefit at all from the recent recovery. There is still a great amount of slackness to be found. The number of unemployed in the city shows a fall of 673 on the week, but still remains at the high total of 34,306. The tool trade with America shows an advance, which is very interesting, in view of the recent imposition of the Fordney Tariff. When that Act came into operation, it was suggested that its effect might not be altogether in favour of the United States, and this would now appear to be the case, since a Sheffield firm manufacturing all classes of tools states that it has had more inquiries from the States during the past six months than in any corresponding period, and it has opened new accounts in that country during the last month.

Cutlery and Plate.

Reports on the condition of these trades vary greatly. Many travellers who have just returned from their New Year journeys have brought back disappointing accounts of the demand that exists in various quarters of the country. Some improvement is noticeable in the colonial trade, but it is still much below the normal. While there is still a very brisk trade in stainless knives, departments devoted to pen and pocket knives and to razors remain extremely quiet, and scissors show but little recovery. Very little new material is at present coming in from Germany, but there are still considerable stocks of German goods in this country which compete severely with the home product. Owing to lower labour costs and cheaper material, the Sheffield cutlery manufacturers have been able to reduce their prices considerably in comparison with those which ruled a year ago, but competition has brought profits down to a very low level.

Water, Gas and Electricity.

The trade slump made itself severely felt in the reduced consumption of water for industrial purposes, and the revenue of the Corporation water department went down so much that it was necessary to increase the charges recently. It now appears that instead of those charges going down soon, they will have to go up again. The Ministry of Health has given the Corporation power to capitalise interest on certain waterworks loans—this being the first time it has entertained such an application—but at the same time it points out that the revenue will be sufficient only if certain conditions are fulfilled, one of which is that there shall be a further increase of charges, which will raise them to about 35 per cent. above the old figure. On the other hand, another Corporation department, the Electric Supply Committee, finds itself able to reduce its charges. The consumption of current during the past year showed a useful increase on the previous period. As from the March readings, it is proposed to make the following reductions:—On all units over 2d. per unit, from 30 to 25 per cent. on the basic rate; on all units, including traction, at 2d. per unit or under, from 75 to 60 per cent. on the basic rate. Simultaneously, the gas company announces a reduction. Its scale, which now ranges from $6^1/_2$d. to 8d. per therm, is to be brought down to $5^2/_3$d. to $7^3/_4$d. Under the revised scale, the highest price will be equivalent to 3s. 2d. per 1000 cubic feet, as against 3s. 4d. at present, while for the largest users the new price will be equal to 2s. 3d. per 1000, as compared with the present 2s. 7d. The local price for large consumers, who use gas for industrial purposes, will be one of the cheapest in the kingdom. The Sheffield Gas Company states that it would be able to make gas still cheaper if it were not for the fact that Sheffield's geographical advantage in the matter of purchasing coal has been destroyed by the Coal Control.

Electricity in Small Houses.

The Electric Supply Committee is taking steps to encourage and popularise the use of electricity in small suburban houses and isolated districts. It proposes that the necessary extensions of mains be carried out by means of overhead lines, in cases where the cost of underground mains would be prohibitive, and that the Watch Committee shall be asked to light the streets with electric lamps hung from poles erected along the routes to be supplied with current in this manner. The Chesterfield Town Council also, which has hitherto made no serious attempt to popularise electricity among the working classes, is now making a move in that direction. It has offered to fit up a house for £7, with an additional £3 10s. for the shilling slot meter, and to include the cost of installation and interest in the unit charge. The charge will be 1½d. per unit to cover installation costs, 1d. per unit for meter rent, and 5½d. per unit for current, making a total of 8d. per unit, which will be reduced to 5½d. when the installation costs are paid off.

Dearne Valley Light Railway.

An interesting forecast as to the probable financial result of the Dearne Valley Light Railway scheme is given in the report of the engineers. As I mentioned last week, the price of the contract which has been accepted for the construction of the 15 miles of line is £200,243, and various other charges will bring up the capital cost of the scheme to £250,000. The engineers state that an average service of 15 min. from Barnsley (i) to Manvers Main and (ii) to Thurnscoe—thus providing an overlapping service of 7½ min. between Barnsley and Wath—is undoubtedly a conservative estimate, and would entail a car mileage of 700,000 miles per annum. Receipts at 20d. per car mile should certainly be exceeded, and allowing a merely nominal sum of £500 per annum on account of the carriage of goods and parcels, advertisements, &c., gross receipts amounting to £58,833 per annum would thus be obtained. Working costs estimated at 13d. per car mile would amount to £37,916 per annum; interest and sinking fund charges, at 6¾ per cent. on £250,000, to £16,875; thus leaving £4042 to be placed to reserve on account of depreciation.

Various Contracts and Schemes.

The important undertakings at Lincoln have booked a good deal of work recently, one of the most successful firms being Clayton Wagons, Limited. It is announced that it has secured orders for the underframes and bogies for four touring saloon coaches for the Bengal-Nagpur Railway, and for eight passenger vehicles for the Indian North-Western State Railway. The same firm has also on hand contracts for no fewer than 3000 12-ton wagons required by several of the colliery companies in the South Yorkshire, Nottinghamshire and South Wales areas. The Sheffield Corporation is erecting new refuse disposal works at Bernard-road. The establishment includes garage, stores and repair shops, and in connection with these a contract for general builders' work, £19,980, and one for structural steelwork, £7022, are recommended for acceptance. Both the contractors are local firms. With a view to finding work for the unemployed, new sewerage schemes, involving an expenditure of about £18,000, are to be put in hand.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

ALTHOUGH great firmness characterises all branches of the iron and steel trades, the situation to some extent is uncertain. Producers generally are well sold, and so far as pig iron is concerned they report little difficulty in booking further forward contracts. At the same time there is certainly not such a clamorous demand for iron from home consumers, who are inclined to think that they may do better by waiting, and high prices are killing the export trade. A few sales are reported to Germany, Belgium and Italy, but, having little iron to dispose of, makers are not seeking continental business, and the export trade is quiet. The position as regards Cleveland prices is embarrassing. Producers recognise that rates obtainable for small odd parcels that become available for prompt sale are absurdly high, and the most recent transactions do not really fix market quotations. For instance, No. 3 G.M.B. Cleveland pig iron has been sold at 110s., but for March-April delivery it is understood that makers would be quite willing to accept 105s. per ton. There is so little No. 1 iron about that it is difficult to obtain a quotation, but the price is fully 5s. per ton above that of No. 3, and No. 4 foundry is about 2s. 6d. per ton below. There are no quotations for forge, mottled and white iron, and generally business is within narrow limits.

Hematite Pig Iron.

Values of East Coast hematite pig iron are steadily advancing, but are still low in comparison with rates ruling for Cleveland pig iron. The statistical position has become very much stronger. There are now practically no stocks, and output is no longer in excess of requirements. Home needs are large and growing, and the demands from overseas are larger. Italy continues to be a big customer, and it is significant to note that America has been buying hematite in this district for March-April delivery. Producers, however, are by no means so keen as they have been to book forward business. Mixed numbers are at a minimum of 105s. per ton, some makers asking up to 107s. 6d. f.o.b.

Iron-making Materials.

Costs of manufacture tend to increase. Durham coke makers now quote 34s. to 35s. per ton as their minimum price for good medium furnace kinds delivered to the works, and only old customers can get even those terms. Foreign ore is stiffening. Best Rubio is 24s. 6d. c.i.f. Tees, and good Mediterranean qualities are quoted up to 23s. 6d. per ton.

Manufactured Iron and Steel.

There is still a good deal of activity in the manufactured iron and steel trade, but in view of increasing costs of production sellers are beginning to show some disinclination to risk forward business. In the semi-finished department the absence of continental material is sharply felt, and a scarcity of some descriptions has developed. Steel scrap has risen to figures users are disinclined to pay. The demand at present is chiefly for shipbuilding material, rails and galvanised sheets. As steel prices include cost of delivery, rather higher prices are being quoted to consumers at a distance.

Blast-furnace Stopped.

Owing purely to accidental causes a hematite furnace at Seaton Carew has gone out of operation, and this reduces the number of furnaces actually in operation on the North-East Coast to 39, of which 12 are on Cleveland pig iron, 14 on hematite, and 13 on basic, ferro-manganese, &c.

Cleveland Mines Re-opening.

Operations are to be resumed next week at the Skinningrove Iron Company's Boulby Mine, where men have for some time been engaged in preparing the workings for the return of the miners. The Spawood Mines at Gisborough were reopened on Monday last after being closed for nearly two years.

The Coal Trade.

The outlook for the Northern coal trade continues bright, but, of course, all eyes are turned to the Franco-German position, although generally merchants are taking the view that whatever happens there will be no relaxation in the demand for British coal. The market has not undergone much in the way of change from last week. All classes of fuel are more or less stable at full quoted prices, and as supplies of any kind for any date within the next two months are severely limited, producers and holders find no difficulty whatever in clearing their output or holdings at top prices. There are no signs at present of any immediate or even approximately early drop in prices. Judging by the surface indications, the appearances point to present quotations holding the field for at least a little time ahead. Most of the collieries report themselves fully sold out to the end of March, and are now ready to treat from April to June and onward: but so far there is not much contracting forward. The inquiries from abroad are said to be rather heavier just now. In addition to the heavy call from Germany, which is even greater than it has been, there is said to be more prospect of increasing trade for France. Many of the usual exporters are receiving quite a number of fresh inquiries for gas, coking and steams for forward dates of loading. There is little movement of any moment, however, in the Northumberland steam coal section. Most of the collieries are sold out, and merchants who have holdings to dispose of are able to clear at full quoted prices. The position for every class of steams is, therefore, very firm, with no apparent disposition to discount in any quarter. The Durham market retains all its recent strength and rigidity. There are numbers of orders in circulation for spot or early prompt for every class of coal, with an exceptional demand for every brand of coking, which makes up to 27s. 3d. per ton quite easily for any date of shipment. Gas coals are scarce, while bunkers are not obtainable easily in any quantity. There is no change in the coke position. Every class of furnace or foundry is sold out direct, and for any available in second hands values are rather inclined to appreciate. Gas coke is also in steady request.

SCOTLAND.

(From our own Correspondent.)

Trade Developing.

THE industrial position continues to improve, and a distinctly hopeful spirit is evident in trade circles generally. The continental situation has brought more orders to local manufacturers, and the chief difficulty at present seems to be in keeping prices down to a really marketable level, and thereby induce buying for future requirements as well as immediate needs. Producers are being forced to rely chiefly on home raw materials, which involve higher costs, and, as already stated, further increases in prices may probably check future buying and retard the development of trade. The increases already imposed have not apparently had any serious effect so far, and the inquiries to hand for all classes of materials indicate expanding markets. Anxiety is especially felt in connection with oversea markets. Export inquiries have been developing on favourable lines, and with the question of price a deciding factor, makers will do their utmost to meet the situation.

New Oxygen Factory.

The British Oxygen Company, Limited, has acquired ground at Leith on which to erect a new factory for the production of oxygen gas, which is principally used in shipbuilding and engineering works for oxy-acetylene cutting and welding of metals. This factory is to supply the East Coast of Scotland. The new buildings will extend to about 14,400 square feet.

Battleship Castings.

It has been mentioned that John Cochrane (Barrhead), Limited, has secured the contract for all the main iron castings for the battleship Rodney, which is to be built by Messrs. Cammell Laird and Co., Birkenhead. The same firm is at present completing an order for the main castings for three other large vessels, also being built by the Birkenhead firm.

Pig Iron.

The Scotch pig iron market is very firm. The increasing demand for hematite and foundry qualities, especially on home account, has meant higher prices, owing to well-filled order books, and the comparatively low state of output. Hematite is in the region of £5 10s.; No. 1 foundry, £5 5s.; and No. 3 foundry, £5 2s. 6d.—all per ton delivered Glasgow. The higher prices seem to have put a slight check on export buying.

Approaching Normal Output.

Employment at the steel works is slowly but surely approaching normal dimensions. The works in operation are all fairly well engaged, and other establishments are gradually being brought into line. It has just been reported that Messrs. Colville have definitely decided to reopen their Clydebridge Steel Works, at Cambuslang, at which no steel has been produced since the autumn of 1921. The preliminary arrangements are already in hand. Steel makers have booked a fair number of orders for plates and sections, enough to guarantee activity for some time ahead. With regard to the former, however, producers would welcome more orders for the heavier class of material. Sheet makers have done more business of late in heavy gauges, and, so far as can be ascertained, find little difficulty in securing orders at the higher prices ruling. Their chief difficulty at present is the shortage of sheet bars and slabs.

Bar Iron Busy.

Along with other producers, bar iron makers are now more happily placed. Home and export demands continue to grow, and employment is becoming more satisfactory. The situation on the Continent has been of some benefit, orders having been diverted to local works. The re-rolled steel bar branch of this industry is also doing comparatively well. Re-rolled steel bars are named about £9 15s. per ton home and £9 5s. per ton export delivery.

Scrap.

There is a general shortage of scrap material, and adequate supplies are difficult to secure. This is especially so in connection with heavy steel. Wrought iron also can hardly be obtained in sufficient quantity.

Coal—Exports Active.

The export demand for almost all descriptions of Scotch coal has shown no falling off. In the West of Scotland ells and splints have been specially busy. Fife-shire collieries have heavy bookings for all classes of steams, and these, along with the Lanarkshire descriptions, are now rather scarce. The business now passing for immediate delivery is confined to small lots, and full record prices, and higher, are easily secured. Lothian steams have booked their share of the business on offer. In all districts a good export demand for washed nuts has been experienced. A more plentiful supply of steamers is now in port, and a loading turn of several days is general. Aggregate shipments amounted to 302,132 tons, against 298,145 tons in the preceding week and 241,607 tons in the same week last year. The home demand continues on recent lines, though perhaps the higher cost of washed nuts has curtailed the turnover in these descriptions.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Position.

GENERALLY speaking, the steam coal trade is not quite as firm as it was a week ago, and there is no denying the fact that in a very large measure the responsibility for this is due to the lack of facilities to effect quick shipment. Coals have been standing, and there has been a plentiful supply of tonnage, but steamers have been kept waiting for berths, and the inability of collieries to get the prompt clearance of wagons has weakened their position and compelled them to accept lower prices than they would otherwise have done. The continuance of these conditions is having more than a temporary effect upon the market in general, notwithstanding that on paper collieries are well sold and really have no coals to spare. In addition to this, bad weather has resulted in a considerable amount of tonnage being delayed, and the prospect is that before very long the congestion at the various docks will be heavier than ever. The inquiry for small coals continues very active, but otherwise the continental demand is somewhat meagre. The adverse state of the foreign exchanges is handicapping operations, and until the conditions in this respect are more favourable it is likely that new business will be rather restricted. At the same time there is no doubt that there is a very considerable quantity of coals to be lifted, otherwise the market would not be anything like as good as it is. Nothing special in the way of contracting for supplies of coals for delivery over a period has been recently arranged, although it is reported that the French State Railways have placed an order for about 10,000 tons of large and a similar quantity of smalls for fairly early delivery.

Dock Facilities.

In a communication to the Press in the early part of this week Sir David Llewellyn, the well-known coalowner, dealt in trenchant form with the South Wales docks question and the restrictive effect of the lack of adequate facilities upon the coal industry. He stated that it was estimated that out of approximately 100,000 wagons employed in the coalfield in the transport of coal from pit to port no less than 70,000 were standing loaded at the collieries, sidings and docks awaiting shipment. At the South Wales ports there were over 450 vessels with a carrying capacity of approximately 1,400,000 tons. But not only were there about 700,000 tons of coal standing awaiting shipment, but the whole of the prospective output and, in the case of many collieries, a great deal more than their prospective output, was actually sold. In the case of the dry coal collieries controlled by himself in the Aberdare Valley, the maximum output available for shipment from these collieries during the remainder of the present month was 60,000 tons. They had actually sold 90,000 tons, or 50 per cent. more than their productive capacity, yet since Christmas these collieries had worked little more than half time. They had at the South Wales ports no fewer than forty vessels chartered for coal or bunkers. Of these, however, only fourteen were under tip loading; the other twenty-six were patiently waiting for berths, and some of them had been in dock for over a week. Sir David Llewellyn describes it as an industrial atrocity that a quarter of a million persons employed in the South Wales coalfield and their wives and children, representing approximately about a million population, should suffer as they are suffering through the action of the tippers and trimmers

Dock Working Hours.

On Monday last all the interests concerned in the question of the revision of working hours at the docks were represented at a conference at Cardiff, but unfortunately nothing definite was done towards removing the congestion at the docks. Whilst the employers reserved to themselves the right to call for a third shift, they submitted fresh proposals for the purpose of negotiation in the hope that they would prove more acceptable to the men's representatives. These proposals were as follows:—Day shift: Monday to Friday, 7 a.m. to 5 p.m., with 1½ hours' interval for meals; Saturday, 7 a.m. to 1 p.m., with ½ hour interval for meals. Night shift: Monday to Thursday, 7 p.m. to 5 a.m., with 1½ hours' interval for meals; and Friday, 6.30 p.m. to 6 a.m., with 1½ hours' interval for meals. It was pointed out that the adoption of these proposals would only involve a working week of forty-eight hours per man, which, it was contended was in contemplation when the eight-hour principle was adopted, and these hours applied to the railwaymen. The men's representatives replied that they were not prepared to agree to any extension of the present number of working hours per week, and although they would refer the employers' proposals to the workmen for consideration, they would not be prepared to recommend them for acceptance. The employers urged that the matter was one of national importance, and suggested that the workmen's leaders should endeavour to put forward some counter-proposals that day in order to obviate any unnecessary loss of time, but the latter were unable to do so with the result that the conference had to be adjourned for a week until Monday next.

Patent Fuel Industry.

For the time being there is no improvement in the patent fuel industry owing to the high cost of pitch, which is about 165s. per ton delivered at the works, or 300 per cent. increase on the pre-war price of this commodity. The South Wales Patent Fuel Manufacturers' Association has addressed a circular to public authorities in South Wales on the question of their reducing their demand for coal tar and pitch for road-making and road-spraying purposes, and drawa attention to the fact that there is available a substitute in very large quantities in the form of asphaltic residues from crude oil distillation and other natural bitumen sources. Apart from this, the manufacturers are taking other steps to endeavour to make themselves independent of the British tar distillers. The Chairman of the Patent Fuel Manufacturers' Association and manager of the Phœnix Patent Fuel Works (Mr. J. Hughes Rice) and Mr. G. E. Thomas, the sales manager of the Craigole Merthyr Fuel Company, left South Wales at the end of last week for the United States in order to investigate the possibility of making arrangements for the supply of pitch, and to give their attention while in America to the question of oil pitch. As a matter of fact, purchases of pitch have already been made, and two steamers have been chartered to bring about 10,000 tons from Pensacola, in the Gulf of Mexico. Mr. Thomas stated before leaving this district that they had purchased a quantity of pitch which would keep them going for a considerable time at a very reasonable figure.

Lower Rates.

The Swansea Harbour Trust, at its monthly meeting on Monday last, approved of its executive's recommendation that the present published schedule of harbour and dock and wharfage rates on goods—other than coal, coke, patent fuel, pit-wood and mining timber—now subject to a rebate of 16⅔ per cent., should be reduced by a further 8⅓ per cent., or 25 per cent. in all, thus making the amended rates in general 50 per cent. above pre-war; also that the wharfage rate on coal, coke, and patent fuel of 3½d. per ton should be increased to 4d. per ton, the same as at other ports in the Channel. A fresh schedule of consolidated rates is to be issued, and all the changes in the rates come into operation as from February 1st.

Current Business.

The steam coal market is irregular for prompt shipment owing to the difficulty of getting a sufficient supply of empty wagons to keep the pits working without interruption. Unfortunately, many owners have not been able to avoid the loss of time at their collieries. At the same time as coalowners are well sold ahead they are not inclined to cut their prices for forward shipment. The feature of the market is the strength of small coals, which are in relatively stronger demand than large coals. Best smalls are quoted at 22s. to 22s. 6d., and even inferior qualities command 17s. to 18s. Coke is firmer at 47s. 6d. to 52s. 6d., and patent fuel, although not generally quoted, is unobtainable at less than 33s. to 37s. 6d. Anthracite coals are rather irregular. The demand for large coals and nuts and cobbles is rather quieter, and the consequence is that duff coals and rubbly culm are scarce and firm. Pit-wood is a shade steadier at 24s. 6d. to 25s. 6d.

Swansea Metal Exchange.

THE Iron and Steel Stabilising Committee of the tin-plate trade has decided that the stabilising arrangement established six months ago is to be continued for a further three months as from April 16th. The minimum price of tin-plates has been advanced by 6d. to 21s. I.C. basis f.o.b., and the minimum price of tin-plate bars by 5s. to £8 6s. per ton, subject to a rebate to tin works of 7s. 6d. per ton. The tin-plate market is firm, though the Central European demand is adversely affected by the Ruhr occupation.

LAUNCHES AND TRIAL TRIPS.

BRITISH FUSILIER, oil tank steamer; built by Swan, Hunter and Wigham Richardson, Limited; to the order of the British Tanker Company, Limited; dimensions, 455ft. by 57ft. beam; to carry 10,000 tons of oil. Engines, turbines of Metropolitan-Vickers-Rateau type; constructed by the builders; launch, December 5th.

RIO CLARO, screw steamer; built by the Blyth Shipbuilding and Dry Docks Company, Limited; to the order of the Thompson Steam Shipping Company, Limited; dimensions, 377ft. by 53ft. 2¼in. by 28ft. 9in. Engines, triple-expansion, 26in., 43in., 73in. by 48in. stroke; constructed by the North-Eastern Marine Engineering Company, Limited; maiden voyage, December 6th.

SAN MANUEL, oil tank steamer; built by Palmers Shipbuilding and Iron Company, Limited; to the order of the Eagle Oil Transport Company, Limited; dimensions, 422ft. by 52ft. 4in. by 31ft. 6in.; to carry 8250 tons deadweight. Engines, triple-expansion, 27½in., 46in., 77in. by 48in. stroke, pressure 180 lb.; constructed by the builders; trial trip, December 6th.

WALLSEND, self-trimming collier; built by Irvine's Shipbuilding and Dry Docks Company, Limited; to the order of the Burnett Steamship Company, Limited; dimensions, 338ft. by 44ft. 3in. by 25ft. 6in.; gross tonnage 4650. Engines, triple-expansion, 22in., 36in., 60in. by 39in. stroke, pressure 180 lb.; constructed by the North-Eastern Marine Engineering Company; trial trip, December 6th.

EDIBA, twin-screw motor vessel; built by Harland and Wolff, Limited; to the order of Elder, Dempster and Co., Limited; dimensions, 420ft. by 54ft. by 35ft. 3in.; gross tonnage 6500. Engines, two six-cylinder four-cycle Diesel oil; constructed by the builders; launch, December 7th.

LOCHGOIL, twin-screw motor vessel; built by Harland and Wolff, Limited; to the order of the Royal Mail Steam Packet Company; dimensions, 502ft. by 62ft. by 38ft. 6in. Engines, two eight-cylinder four-cycle Diesel oil; constructed by the builders; trial trip, December 14th.

CITY OF CANTERBURY, single-screw cargo and passenger steamer; built by Swan, Hunter and Wigham Richardson, Limited; to the order of Ellerman Lines, Limited; dimensions, 448ft. by 56ft. 4in. by 34ft. 1in.; to carry, 10,000 tons deadweight. Engines, quadruple-expansion; constructed by the builders; launch, December 16th.

ORCA, passenger liner; reconditioned by the builders, Harland and Wolff, Limited; to the order of the Pacific Steam Navigation Company; dimensions, 575ft. 8in. by 67ft. by 47ft.; gross tonnage 16,000. Engines, triple screw, pressure 215 lb.; constructed by the builders; left port, December 16th.

BRITISH PREMIER, oil tank steamer; built by Palmer's Shipbuilding and Iron Company, Limited, to the order of the British Tanker Company, Limited; dimensions, 415ft. by 54ft. by 33ft.; 8400 tons deadweight. Engines, single-screw double reduction geared turbines, pressure 200 lb.; constructed by the builders; trial trip, December 20th, 1922.

NARINGA, geared turbine steamer; built by William Gray and Co., Limited, to the order of the British India Steam Navigation Company, Limited; dimensions, 451ft. by 57ft. by 32ft. 10in.; 10,600 tons deadweight. Engines, single-screw double reduction geared turbines, pressure 225 lb.; constructed by the builders; launch, December 18th, 1922.

RALLUS, steel screw steamer; built by Swan, Hunter and Wigham Richardson, Limited, to the order of the British and Continental Steamship Company, Limited; dimensions, 290ft. by 42½ft. beam. Engines, triple-expansion; constructed by the builders; trial trip, December 29th, 1922.

ENGINEERING GOLFING SOCIETY.—The annual general meeting of the Engineering Golfing Society will be held at the Institution of Civil Engineers on Wednesday, February 28th, at 12 o'clock noon.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	22/6
(1) Spanish	21/6
(1) N. African	21/6
N.E. COAST—	
Native	—
Foreign (c.i.f.)	24/6 to 25/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	5 10 0	—
No. 1 Foundry	5 10 0	—
No. 3 Foundry	5 5 0	—
N.E. COAST—		
Hematite Mixed Nos.	5 6 0	5 6 0
No. 1	5 7 0	5 7 0
Cleveland—		
No. 1	5 15 0	5 15 0
Silicious Iron	5 15 0	5 15 0
No. 3 G.M.B.	5 10 0	5 10 0
No. 4 Foundry	5 7 6	5 7 6
No. 4 Forge	—	—
Mottled	—	—
White	—	—
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
North Staffs. Forge	4 2 6	—
,, ,, Foundry	4 10 0	—
(3) Northampton—		
Foundry No. 3	4 7 6	—
,, Forge	3 19 0	—
(3) Derbyshire—		
No. 3 Foundry	4 12 6 to 4 15 0	
Forge	4 0 0	—
(3) Lincolnshire—		
Basic	5 0 0	—
Foundry	4 10 0 to 5 0 0	
Forge	4 5 0 to 4 10 0	
(4) N.W. COAST—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	5 17 6 to 6 2 6	

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 0 0	10 10 0
Best ,,	12 0 0	—
N.E. COAST—		
Crown Bars	11 0 0	—
Tees	10 0 0	—
LANCS.—		
Crown Bars	12 0 0	—
Second Quality Bars	11 5 0	—
Hoops	15 0 0	14 15 0
S. YORKS.—		
Crown Bars	11 10 0 to 12 0 0	
Best ,,	12 10 0	—
Hoops	15 0 0	—
MIDLANDS—		
Crown Bars	11 0 0 to 11 10 0	
Marked Bars (Staffs.)	13 10 0	—
Nut and Bolt Bars	10 10 0	—
Gas Tube Strip	10 15 0 to 11 5 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	12 0 0	—
Ship Plates ¾in. and up	9 5 0	—
Sections	9 0 0	—
Steel Sheets ⅛in. to ¾in.	11 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	19 0 0

STEEL (continued)

N.E. COAST—	Home. £ s. d.	Export. £ s. d.
Ship Plates	9 10 0	—
Angles	9 0 0	—
Boiler Plates	13 0 0	—
Joists	9 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0 to 14 0 0	
Channels	9 5 0	—
Hard Billets	8 15 0	—
Soft Billets	8 0 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 0 0	—
Light ,,	10 0 0 to 10 10 0	
Billets	9 0 0	—
MANCHESTER—		
Bars (Round)	9 0 0 to 9 10 0	
,, (others)	9 10 0 to 10 0 0	
Hoops (Best)	14 15 0	14 10 0
,, (Soft Steel)	12 15 0	12 10 0
Plates	9 0 0 to 10 0	
,, (Lancs. Boiler)	13 10 0	—
SHEFFIELD—		
Siemens Acid Billets	11 0 0	—
Bessemer Billets	12 10 0	—
Hard Basic	9 5 0	—
Intermediate Basic	9 0 0	—
Soft Basic	8 15 0	—
Hoops	12 15 0 to 13 0 0	
Soft Wire Rods	10 0 0 to 10 13 0	
MIDLANDS—		
Small Rolled Bars	9 15 0 to 10 0 0	
Billets and Sheet-bars	8 5 0 to 8 15 0	
Gas Tube Strip	10 5 0 to 10 10 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets (f.o.b. L'pool)	18 15 0 to 19 0 0	
Angles	9 15 0	—
Joists	9 15 0	—
Tees	10 15 0	—
Bridge and Tank Plates	9 15 0 to 10 0 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	21/- to 21/6
Block Tin (cash)	186 15 0
,, (three months)	183 7 6
Copper (cash)	65 17 6
,, (three months)	66 12 6
Spanish Lead (cash)	28 7 6
,, (three months)	28 0 0
Spelter (cash)	35 2 6
,, (three months)	34 12 6
MANCHESTER—	
Copper, Best Selected Ingots	71 10 0
,, Electrolytic	73 0 0
,, Strong Sheets	96 0 0
,, Loco Tubes	0 1 1½
Brass Loco Tubes	0 1 0
,, Condenser	0 1 1½
Lead, English	29 10 0
,, Foreign	28 10 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit
Tungsten Metal Powder	1/11 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23	10/6
,, 6 p.c. to 8 p.c. ,,	£21 0 0	8/-
,, 8 p.c. to 10 p.c. ,,	£20 0 0	8/-
,, Specially Refined		
,, Max. 2 p.c. carbon	£54 0 0	20/-
,, ,, 1 p.c. ,,	£64 0 0	22/6
,, ,, 0·75 p.c. carbon	£72 0 0	25/-
,, carbon free	1/6 per lb.	
Metallic Chromium	4/6 per lb.	
Ferro Manganese (per ton)	£15 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£11 15 0 scale 5/- per unit	
,, ,, 75 p.c.	£20 0 0 scale 6/- per unit	
,, Vanadium	17/- per lb.	
,, Molybdenum	9/- per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£180	
Cobalt	11/- per lb.	
Aluminium (per ton)	£82 to £100 (British Official.)	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	25/6
,, ,, Ell	26/3
,, ,, Splint	27/6 to 30/-
,, ,, Trebles	24/-
,, ,, Doubles	23/-
,, ,, Singles	21/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	25/6
,, ,, Splint	27/6
,, ,, Trebles	24/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	24/6 to 27/6
Screened Navigation	32/-
Trebles	24/6
Doubles	23/-
Singles	22/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	25/-
Secondary Steam	25/3
Trebles	24/9
Doubles	23/6
Singles	22/-

ENGLAND.

(8) N.W. COAST—	
Steams	29/-
Household	46/3 to 57/6
Coke	36/-
NORTHUMBERLAND—	
Best Steams	27/6 to 28/-
Second Steams	26/- to 26/6
Steam Smalls	17/- to 18/-
Unscreened	20/6
Household	25/- to 28/-
DURHAM—	
Best Gas	26/- to 27/-
Second	26/-
Household	25/- to 28/-
Foundry Coke	55/- to 60/-

SHEFFIELD—	INLAND.
Best Hand-picked Branch	32/6 to 34/6 —
Barnsley Best Silkstone	28/- to 30/- —
Derbyshire Best Brights	25/6 to 27/6 —
,, ,, House	23/- to 24/6 —
,, ,, Large Nuts	20/6 to 22/6 —
,, ,, Small ,,	15/- to 16/6 —
Yorkshire Hards	21/- to 22/- —
Derbyshire ,,	20/- to 21/- —
Rough Slacks	9/6 to 11/- —
Nutty ,,	7/9 to 9/9 —
Smalls	3 - to 5/- —
Blast Furnace Coke (inland and Export)	22/- to 30/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	29/- to 30/-
Second ,, ,,	28/- to 29/-
Best Dry Large	27/6 to 28/6
Ordinary Dry Large	26/6 to 27/6
Best Black Vein Large	28/- to 29/-
Western Valley ,,	28/- to 28/6
Best Eastern Valley Large	27/6 to 28/-
Ordinary ,, ,,	27/- to 27/6
Best Steam Smalls	21/- to 22/-
Ordinary ,,	17/6 to 20/-
Washed Nuts	25/- to 32/6
No. 3 Rhondda Large	29/- to 30/-
,, ,, Smalls	19/- to 21/-
No. 2 ,, Large	26/- to 27/-
,, ,, Through	21/6 to 23/-
,, ,, Smalls	16/- to 17/-
Coke (export)	47/6 to 52/6
Patent Fuel	35/- to 37/6
Pitwood (ex ship)	24/6 to 25/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	35/- to 37/6
Seconds	30/- to 32/6
Red Vein	29/- to 30/-
Machine-made Cobbles	50/- to 52/6
Nuts	52/6 to 55/-
Beans	45/- to 47/6
Peas	21/- to 23/-
Breaker Duff	11/- to 12/-
Rubbly Culm	14/- to 14/6
Steam Coals:	
Large	26/- to 27/-
Seconds	23/- to 25/-
Smalls	13/6 to 15/-
Cargo Through	18/- to 22/6

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—F.O.B. Glasgow.

(8) Except where other wise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b

French Engineering Notes.

(From our Correspondent in Paris.)

The Industrial Blockade.

THE economic war which is being waged in the Ruhr is, for the time being, causing considerable embarrassment in this country. Notwithstanding the efforts the French are making to organise the occupied territory, everything is being completely disorganised by the strikes and the passive resistance which it is hoped to overcome eventually by expelling all turbulent elements and replacing the strikers with French railwaymen and others, but the difficulties are so great that they can only be vanquished by dint of firmness and untiring patience. The only sure thing is that the French are determined to carry on this economic war to the bitter end. Meanwhile, very little coke is coming into France for the blast-furnaces, of which about two-thirds have been damped down, a course which has had an immediate and disastrous effect upon the metallurgical trades which cannot do business because it in impossible to fix prices. The blast-furnace owners are unable to get quotations for future delivery, and are asked to wait until the situation becomes a little clearer, but even supposing that coke was forthcoming to meet requirements, there would still be considerable delay before the blast-furnaces could be in operation again. Consumers have now resigned themselves to an inevitable shortage during, it may be, a long period, and it has been freely stated in Paris that prices will be doubled in the next few weeks. Merchants are holding on to their stocks of rolled iron, and will only supply limited quantities to regular customers. The anxiety of consumers to procure iron and steel emphasises the general feeling that we have entered upon a period of general shortage. Those engineering concerns that possess large quantities of raw material are able to accept new contracts, but constructional engineers generally experience great difficulty in covering their needs. The situation has been aggravated by the heavy depreciation of the franc, which is, of course, a natural corollary of the inevitable financial stringency, and is also caused partly by the heavy purchases of raw material abroad. Efforts are being made to procure coke from England, but apart from the very high price that has to be paid, owing to the lessened value of the franc, the supplies obtainable are very limited. The situation therefore turns entirely upon the course of events in the Ruhr. If the French are able to organise that territory in a way that will permit of their supplying the blast-furnaces with coke, the industrial position may in time become normal, but if the economic war is to be carried on indefinitely without adequate results it can only end in disaster. The opinion is held, however, that everything points to the fact that the French are steadily making headway and that, as the Germans are suffering more from the industrial blockade, the resistance will end abruptly.

Motor Rail Cars.

In September of last year the Minister of Public Works appointed a Commission to report upon the advantages offered by motor rail cars on local lines where the number of trains has to be reduced to a minimum on account of the unprofitable character of the service. It is hoped that the use of internal combustion engines will allow of a normal service being assured under conditions of working cost that will permit of the lines being self-supporting. The Commission has carried out tests with two types of motor cars—one a light motor employed on the metre gauge lines in the Aisne, Deux Sèvres and Indre, and the other a heavier type capable of hauling an ordinary railway coach when the traffic is particularly heavy. It was found that the total cost of running a light motor of 25 to 30 horse-power with a trailing car was 1.14 franc per kilometre, and of the heavier vehicle, without a trailing coach, 1.30 franc per kilometre. On the metre gauge line the cost of running trains with steam locomotives is 2.25 francs per kilometre, so that the petrol engine represents an economy of nearly one half. The Commission's report does not suggest the exclusive employment of petrol motor cars on local lines which are not paying their way, but proposes them merely as a supplementary service to the steam locomotives used for normal traffic, the rail motors being destined more particularly to ensure a more frequent passenger service. On many local lines it has been found necessary to reduce the number of trains with steam locomotives to two or three a day, but with the use of petrol cars it will, it is hoped, be possible to run trains more frequently. The way in which this should be done, as well as the selection of the most suitable types of vehicles, must depend upon the railway companies themselves, which are encouraged to carry out exhaustive tests with the aid of the subsidies to be offered by the Minister of Public Works.

Keeping Trade.

The annual report of the British Chamber of Commerce in Paris lays special stress upon the necessity of British firms doing their best to maintain a hold upon this market, even at the cost of big concessions, for once the trade is lost it may be a very long time before it is recovered. It is true that the conditions for doing business were never so unfavourable as they are now, first on account of the exchange rate and then because of the measures being adopted to restrict the activities of foreigners and relieve the country as much as possible of its dependence on foreign sources of supply. The Bill prohibiting foreigners from purchasing real estate may be considerably modified by the Senate, but nothing can be done to remove the tension of the exchange rate, while the industrial policy is distinctly in the direction of offering every protection to home industries. Still, it does not need any return to normal change rate conditions to open the market to British goods, and it is satisfactory to find that certain British firms continue to maintain their French connection by selling their manufactures on the basis of a fixed rate of exchange. When the trouble is cleared up in the Ruhr it is fully expected that the exchange rate will come back to a workable level enabling British traders to do business under satisfactory conditions.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

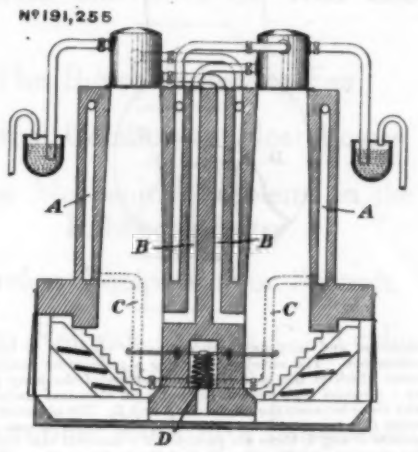
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

GAS PRODUCERS.

191,255. December 8th, 1921.—A SMALL GAS PLANT, J. R. Duff, Warkworth House, Banbury.

THIS plant is intended for the production of "straight" coal gas or a mixture with water gas on a comparatively small scale. Two retorts are arranged side by side and each is surrounded by an annular chamber A. Both retorts have stepped grates. In operation the retorts are worked alternately to make water gas and coal gas. Thus one is filled with hot coke and the gas it

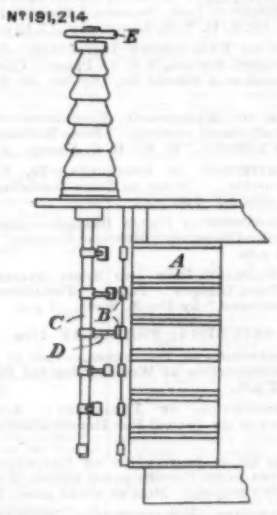


generates is burnt in the annular chamber of the other retort, which is filled with coal. The gas given off by the second retort is passed to the mains. The connecting passages B are used when it is desired to mix the water gas from one retort with the coal gas from the other, while the dotted passages C are the outlets from the annular chambers to the chimney flue. D is a boiler for supplying the steam to make water gas.—*January 11th*, 1923.

TRANSFORMERS.

191,214. October 31st, 1922.—IMPROVEMENTS IN OR RELATING TO ELECTRICAL TRANSFORMERS, Henry Albert Turfrey Packford, of Pinkhill, Eynsham, Oxford.

The object of this invention is to bring various sections of the secondary winding of a transformer into operation in simple and effective manner. The secondary coils A are connected by tappings to contacts B mounted on a bar of insulated material.

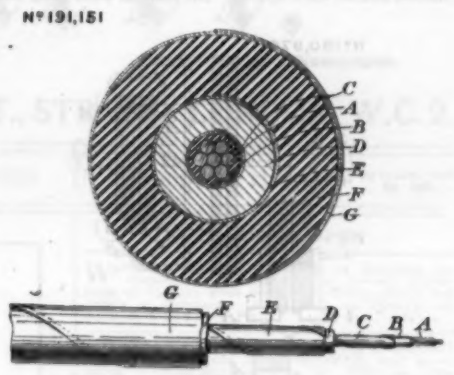


The switch-operating member consists of a spindle C carrying a number of contact arms D, adapted to co-operate with the stationary contacts, and the different tappings are brought into use by turning the handle E.—*January 11th*, 1923.

TELEGRAPHS AND TELEPHONES.

191,151. October 5th, 1921.—IMPROVEMENTS IN OR RELATING TO SUBMARINE TELEGRAPH CABLES, Herbert Watson Sullivan, of Winchester House, Old Broad-street, London, E.C. 2.

Numerous attempts have been made to reduce the capacity of a cable and to increase its self-induction, and the present invention constitutes a further step in that direction. The signalling conductor A is lightly insulated at B by means of enamel or gutta-percha. A length of iron strip C is laid along the signalling conductor and outside the insulation by winding it spirally along the conductor with a fast lay. For further security this iron may be enamelled prior to being laid in position. The conductor thus loaded with magnetic material is then enclosed in an insulating sleeve D of impregnated paper. The impregnating material may be wax or any other substance commonly employed for impregnating paper. Outside the paper sleeve is a second spiral winding of thin iron tape or ribbon E, and outside this is a sleeve of gutta-percha F, which is provided to protect the paper against water, and, if desired, a further wrapping of iron may be

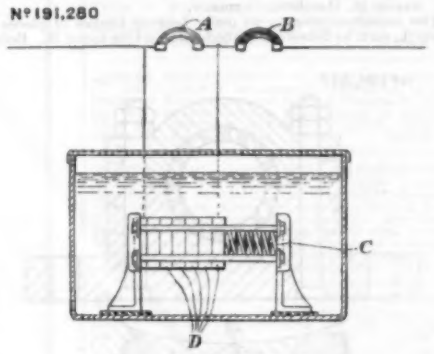


added outside the gutta-percha as shown at G.—*January 5th*, 1923.

SWITCHGEAR.

191,280. December 19th, 1921.—IMPROVEMENTS IN AND RELATING TO ELECTRIC CIRCUIT BREAKERS, *The British Thomson-Houston Company, Limited, of* 83, *Cannon-street, E.C.* 4.

The operation of the switch described in this specification will readily be understood from the diagram. When the contacts A and B are closed the spring C forces the carbon plates D into close contact with one another. When, however, the circuit is broken at A the current is transferred to the carbon pile. The passage of the current through the pile causes a considerable

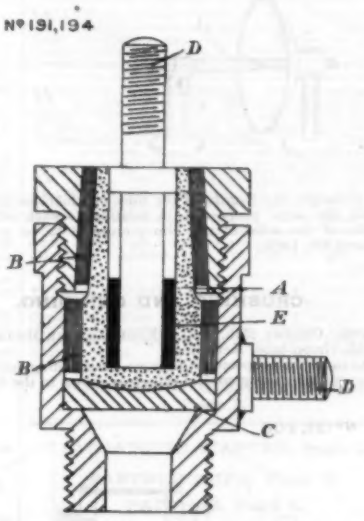


amount of heating, with the result that the oil which is present in the vessel containing the pile is vaporised and the vapour acting on the pile forces the plates apart. Arcs are thus formed between the plates and this causes a further vaporisation of the oil, which in turn forces the plates further apart until the circuit is finally broken and the arcs are extinguished. The switch B is then opened and the spring C forces the plates back into their initial position.—*January 11th*, 1923.

MEASURING AND TESTING INSTRUMENTS.

191,194. October 17th, 1921.—AN ELECTRICAL INDICATOR, E. L. M. Emtage, Air Ministry, Alexandra House, Kingsway, London.

This indicator depends for its action on the variation of the electrical conductivity of a material such as lithographic stone when subjected to varying pressures. The stone is indicated at A and is insulated by the bushings B B. The plate C is subject,



below, to the pressure in the cylinder which it is desired to indicate and presses, above, against the stone. The electrical circuit is completed through the terminals D D and the mercury E. A current is passed through the device and through an oscillograph, which indicates the variations in the current and thus those of the cylinder pressure.—*January 11th*, 1923.

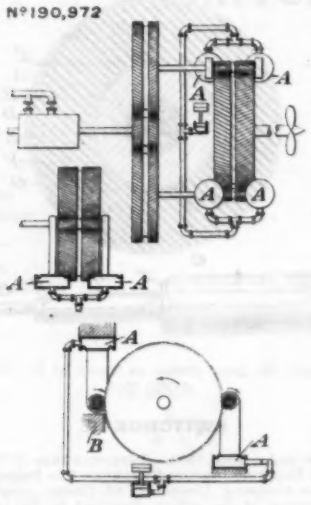
TRANSMISSION OF POWER.

190,972. May 10th, 1922.—TURBINE GEARING, *A. S. Cachemaille, 2, Norfolk-street, Strand, Westminster.*

The object of the arrangement described in this specification is the equalisation of the loads on the two pinions of a double reduction train of gearing. The reactions from the bearings of

the pinions are thus taken by the diaphragms of a set of chambers A, one to each bearing, which are in communication with one another and are filled with oil. The reaction when going astern,

Nº 190,972



being only about one-half that of going ahead, is taken on a solid abutment B of one double pinion only.—*January 4th*, 1923.

191,317. March 10th, 1922.—BEARING LINERS, G. A. R. Kühne, Schäferkampsallee 61, Hamburg, Germany, and the Maschinen- und Wellenlager-Gesellschaft, Dammthorstrasse 14, Hamburg, Germany.

The inventors propose to make bearing bushes of pieces of stone A, such as limestone embedded in white metal B. Before

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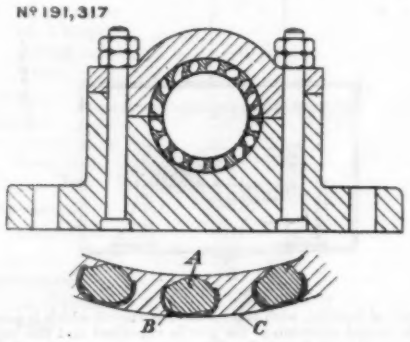


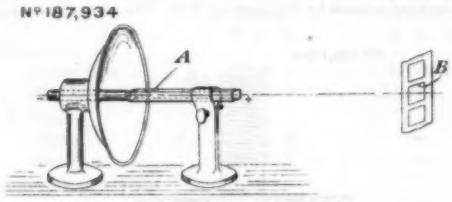
the metal is cast round the stones they are put in sheet metal gutters which run from end to end of the bearing.—*January 11th*, 1923.

LIGHTING AND HEATING

187,934. November 15th, 1921.—IMPROVEMENTS IN ARC LAMPS FOR PROJECTION PURPOSES, Fried. Krupp Aktiengesellschaft, of Essen, Germany.

The arc lamp described in this specification is designed to utilise the light to good advantage. This object is obtained by making the light-emitting or positive carbon A in the form

Nº 187,934



of a rectangle, the lengths of the sides of which having approximately the same proportion in relation to each other as the lengths of the sides of the film picture B to be projected.—*January 4th*, 1923.

CRUSHING AND GRINDING.

191,208. October 25th, 1921.—EDGE RUNNER MILLS, J. Wass, 53, Green-lane, Kettering.

The inventor proposes to improve the grinding action of edge runner mills by using conical rollers as shown in the illustration.

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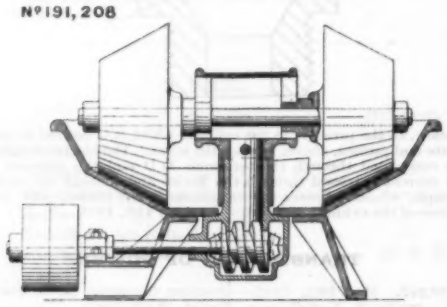


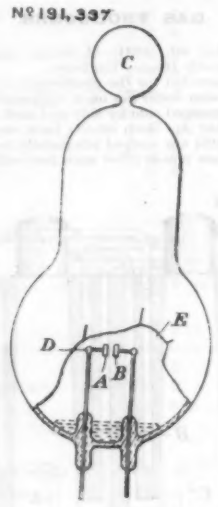
The rollers have their greater diameters towards the centre of the pan, with the result that there must be a considerable amount of slip between the rolls and pan.—*January 11th*, 1923.

MISCELLANEOUS.

191,337. June 17th, 1922.—IMPROVEMENTS IN AND RELATING TO ELECTRIC INCANDESCENT ARC DEVICES, *The British Thomson-Houston Company, of Crown House, Aldwych, W.C.* 2.

This invention relates to devices in which an arc is operated in a gaseous atmosphere and in which the negative electrode alone or both electrodes operate at incandescence. It has been discovered that when a section of the current conveying conductor adjacent to the cathode is associated with a material having a higher electron emissivity than the rest of the conductor the arc will be confined to the electrode. The particular device illustrated is intended to operate as a lamp and the electrodes A and B are of the same size. Both electrodes are preferably composed

Nº 191,337



of tungsten, and they are both ordinarily operated at bright incandescence. The envelope contains a gaseous or gasifiable material which at the operating temperature of the lamp produces a pressure high enough to enable an electrical discharge to take place between the electrodes A and B. The object of the chamber C is to control the pressure of the vapour or gas. At the points D and E there are particles of a material that have a higher electron emission than that of the lead-in wires. When the arc is produced by direct current it is only necessary to provide the cathode with high electron emissivity material. One of the advantages of the invention is that the arc does not play between the leading-in conduntors during the starting period, and flickering is also said to be minimised.—*January 11th*, 1923.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—University College, Singleton Park, Swansea. Paper, "Research and Industry," by Mr. F. C. A. H. Lantaberry. 7.15 p.m.

INSTITUTION OF ENGINEERING INSPECTION.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Paper, "Chemical Inspection as it Is and as it Should Be," by Mr. H. T. F. Rhodes. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, S.W. 1. Annual general meeting. "Some Mechanical Problems in the Rubber Industry," by Mr. H. C. Young. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Lecturette: "Notes on Some Insulating Materials," by Mr. T. L. Allison. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Discourse, "Muscular Exercise," by Professor A. V. Hill. 9 p.m.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE.—Royal Technical College, Glasgow. Paper, "The Corrosion of Steel Furnace Refractories," by Dr. A. Scott. 7 p.m.

SATURDAY, FEBRUARY 17TH.

JUNIOR INSTITUTION OF ENGINEERS.—Visit to the buildings in course of construction at Wembley for the British Empire Exhibition. 2 p.m.

JUNIOR INSTITUTION OF ENGINEERS: NORTH-EASTERN SECTION.—Visit to the Central Fire Brigade Station, Newcastle-on-Tyne.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Visit to the Carville power station of the Newcastle Electric Supply Company. Meet at works gates, 2.30 p.m.

WEST YORKSHIRE METALLURGICAL SOCIETY.—Technical College, Bradford. "Cast Iron," by Mr. E. Adamson. 7 p.m.

MONDAY, FEBRUARY 19TH.

BRADFORD ENGINEERING SOCIETY.—The Technical College, Bradford. "Aerial Ropeways" (Slides), by Mr. H. Roe. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—The College, Loughborough. Loughborough Graduates' meeting. Paper, "The Process of Ignition," by Mr. A. P. Young. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: SCOTTISH CENTRE.—Royal Technical College, Glasgow. Paper, "High-speed Oil Engines," by Mr. J. L. Chaloner. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: NEWCASTLE-UPON-TYNE ASSOCIATION.—Neville Hall, Newcastle-upon-Tyne. Paper, "The Water-tight Fitting of Dock Gates," by Mr. D. D. Stanier. 7.30 p.m.

NORTHAMPTON ENGINEERING COLLEGE ENGINEERING SOCIETY.—St. John-street, E.C. 1. Lecture, "The Construction of the Atom," by Mr. H. Buckley. 5.30 p.m.

TUESDAY, FEBRUARY 20TH.

ILLUMINATING ENGINEERING SOCIETY.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Discussion on "The Projection of Light," opened by Messrs. W. Jones and E. A. Marx. 8 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Broadgate Café, Coventry. Meeting of the Coventry Graduates. Paper, "Motor Frames," by Mr. B. W. Dawkins. 7.45 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Papers for discussion:—"Colombo Main Drainage," by Mr. R. E. Tickell; "Evolution in Sewage Disposal, with special regard to South African Experience in Sludge Treatment, particularly at Pretoria," by Mr. F. W. Jameson; "Main Drainage of the Southern Suburbs of the City of Capetown, South Africa," by Mr. D. E. Lloyd-Davies. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS; NORTH MIDLAND CENTRE.—The Metropole, King-street, Leeds. Paper: "Some Problems in High-speed Alternators and their Solution," by Mr. J. Rosen. 7 p.m.

INSTITUTE OF TRANSPORT.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. Graduates' and Students' lecture: "Modernisation of Passenger Railway Stations," by Messrs. F. Bushrod and J. F. S. Tyler. 5.30 p.m.

WEDNESDAY, FEBRUARY 21ST.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Chamber of Commerce, New-street, Birmingham. Birmingham Graduates' meeting. Paper, "Springing Systems for Cars," by Mr. E. N. Salmon. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Institution of Mechanical Engineers, Storey's-gate, S.W. 1. Informal meeting. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: WOLVERHAMPTON CENTRE.—Star and Garter Hotel, Wolverhampton. Paper, "The Technique of Calculation," by Mr. James Watt. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Informal meeting. Discussion, "A Comparison of American and Canadian Methods of Engineering with English," introduced by Mr. G. W. M. Boycott. 7 p.m.

ROYAL METEOROLOGICAL SOCIETY.—49, Cromwell-road, South Kensington, S.W. 7. General meeting. 7.30 p.m.

ST. BRIDE RADIO AND EXPERIMENTAL SOCIETY.—St. Bride Foundation Institute, Bride-lane, Fleet-street, E.C. 4. Inaugural meeting. 7.30 p.m.

SOCIETY OF GLASS TECHNOLOGY.—Armstrong College, Newcastle-upon-Tyne. General meeting. 2.45 p.m.

UNIVERSITY OF LONDON.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. "The Control of the Speed and Power Factor of Induction Motors." Lecture I., "Characteristics of the Induction Motor, &c.," by Professor Miles Walker. 5.15 p.m.

THURSDAY, FEBRUARY 22ND.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, W.C. 2. Lecture, "Transoceanic Wireless Telephony," by Dr. H. W. Nichols. 6 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS (LONDON).—The Engineers' Club, Coventry-street, W. 1. "Training of Apprentices," by Mr. W. S. Edwards. 7 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS.—Denison House, 296, Vauxhall Bridge-road, S.W. 1. Paper: "Shear Resistance," by Mr. E. Godfrey; will be read by Mr. H. K. Dyson. 7.30 p.m.

FRIDAY, FEBRUARY 23RD.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Lecturette, "Characteristics, Operation and Maintenance of Underground Cables," by Mr. A. J. Tracey. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Discourse, "The Interior of a Star," by Professor A. S. Eddington. 9 p.m.

SATURDAY, FEBRUARY 24TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Visit of the London Graduates to the works of Sparklets, Limited, Upper Edmonton, N. 18; nearest station, Angel-road, G.E.R. Meet outside the works, 2.30 p.m.

MONDAY, FEBRUARY 26TH.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' SECTION, LONDON.—Storey's-gate, S.W. 1. Annual lecture. "Photo-elastimetric Researches on Mechanical Engineering Problems," by Professor E. G. Coker. 7 p.m.

UNIVERSITY OF LONDON.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. Lecture, "The Control of the Speed and Power Factor of Induction Motors." II., "Various Methods of Changing the Speed of Induction Motors, &c." 5.15 p.m.

TUESDAY, FEBRUARY 27TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: COVENTRY CENTRE.—Railway Hotel, Coventry. Paper, "High-speed Oil Engines," by Mr. J. L. Chaloner. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: YORKSHIRE ASSOCIATION.—Philosophical Hall, Leeds. Lecture, "Engineering Factory Organisation," by Sir Henry Fowler. 7.30 p.m.

INSTITUTE OF MARINE ENGINEERS, 85–88, The Minories, Tower Hill, E. 1. "Auxiliary Machinery," by Engineer-Commander R. Beeman. 6.30 p.m.

WEDNESDAY, FEBRUARY 28TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Visit of the Birmingham Graduates to the works of Serck Radiators, Limited, Warwick-road, Greet. 2.45 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: NORTH OF ENGLAND CENTRE.—Education Offices, Salford. Paper, "High-speed Oil Engines," by Mr. J. L. Chaloner. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: YORKSHIRE ASSOCIATION.—Royal Victoria Station Hotel, Sheffield. Lecture, "Engineering Factory Organisation," by Sir Henry Fowler. 7 p.m.

WEDNESDAY AND THURSDAY, MARCH 7TH AND 8TH.

INSTITUTE OF METALS.—Institution of Mechanical Engineers, Storey's-gate, S.W. 1. Annual general meeting, 10 a.m. to 5 p.m. on each day. Annual dinner, Trocadero Restaurant, Piccadilly-circus, W. 1, on Wednesday, 7th, 7.30 p.m. for 8 p.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE VISCO ENGINEERING COMPANY, Limited, of 82, Victoria-street, London, S.W. 1, informs us that it has appointed the following additional representatives:—Mr. Norman A. Lane, 21, Bennett's-hill, Birmingham, for the Birmingham district; Mr. L. M. Russell Cox, Arrad House, Whitehall-road, Rugby, for the South Midlands district; Mr. Wm. Wilde, West Carr-lane, Stoneferry, Hull, for the Hull district; and Mr. Alex. C. Scott, 102, St. Mary-street, Cardiff, for the South Wales district.